DOCUMENT RESUME

ED 072 787 LI 004 140

AUTHOR	Barron, Paul; Narin, Francis
TITLE	Analysis of Research Journals and Related Research Structure in Education. Final Report.
INSTITUTION	Computer Horizons, Inc., Chicago, Ill.
SPONS AGENCY	National Center for Educational Research and Development (DHEW/OE), Washington, D.C. Regional Research Program.
BUREAU NO	BR-1-E-164
PUB DATE	31 Oct 72
CONTRACT	OEC-5-72-0022(509)
NOTE	68p.; (21 References)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Content Analysis; Educational Psychology; *Educational Research; Interprofessional Relationship; *Psychology; *Scholarly Journals

ABSTRACT

This study delineates the structure of the educational journal literature, and its relationship to surrounding psychological journals. Citations amongst 140 heavily cited, widely circulating journals were used to define the interrelationships between the journals, and by inference between the research areas they represent. All education journals of wide circulation which contained 100 or more references per year were used in the study. All of the maps and measures emphasize the dominant influence psychology has as the primary source of knowledge for education research. Elementary education and guidance are in the mainstream of education literature while higher and general education are not. Science education and special education are compact, self contained subfields having few connections with other education literature. Two-step citation maps linked each journal with the two journals it cites most frequently. The citation chains formed subfields maps showing the interrelationships between different graphic clusters of journals. A cluster analysis, using all of the citations from each journal, confirmed the subfield clusters generated by the graphic methodology. Hierarchies were constructed illustrating dependency relationships between the individual journals and between clusters of journals. Procedures were developed which isolated general and subfield core journals, and journals peripheral to education. (Author)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEH REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

ED 072787

FINAL REPORT

Project No. 1-E-164
Contract No. OEC-5-72-0022 (509)

ANALYSIS OF RESEARCH JOURNALS AND RELATED RESEARCH STRUCTURE, IN EDUCATION

Paul Barron
and
Francis Narin

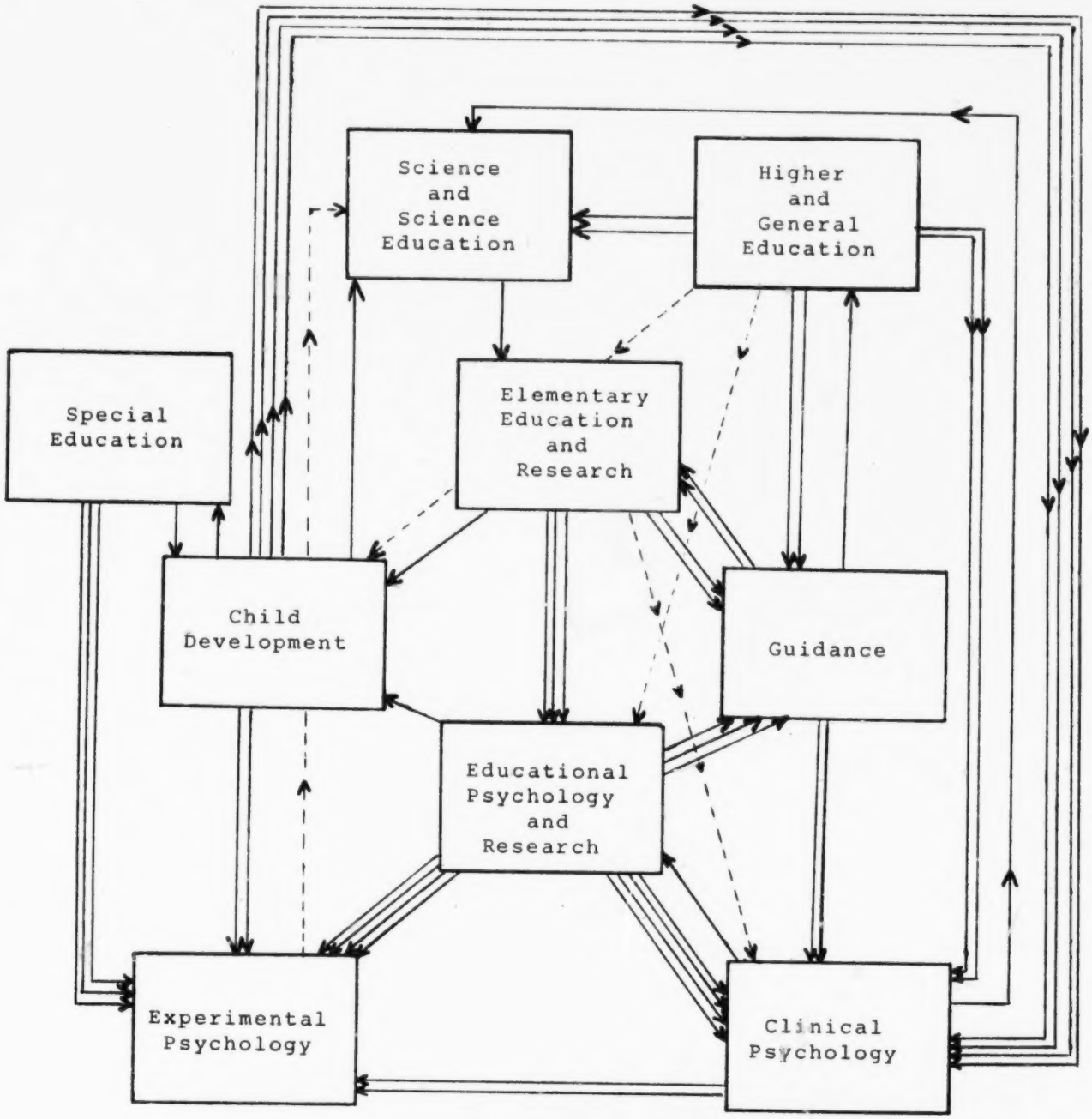
Computer Horizons, Inc.
53 West Jackson Boulevard
Chicago, Illinois 60604

October 31, 1972

The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
National Center for Educational Research and Development



FRONTISPIECE - CITING BETWEEN SUBFIELDS OF EDUCATION

ABSTRACT

This study delineates the structure of the educational journal literature, and its relationship to surrounding psychological journals. Citations amongst 140 heavily cited, widely circulating journals were used to define the interrelationships between the journals, and by inference between the research areas they represent. All education journals of wide circulation which contained 100 or more references per year were used in the study.

All of the maps and measures emphasize the dominant influence psychology has as the primary source of knowledge for education research. Elementary education and guidance are in the mainstream of education literature while higher and general education are not. Science education and special education are compact, self contained subfields having few connections with other education literature.

Two-step citation maps linked each journals with the two journals it cites most frequently. The citation chains formed subfield maps showing the interrelationships between different graphic clusters of journals. A cluster analysis, using all of the citations from each journal, confirmed the subfield clusters generated by the graphic methodology.

Hierarchies were constructed illustrating dependency relationships between the individual journals and between clusters of journals. Procedures were developed which isolated general and subfield core journals, and journals peripheral to education.

TABLE OF CONTENTS

Section		Page
I	INTRODUCTION	1
II	BACKGROUND	3
III	DATA ACQUISITION	5
IV	TWO-STEP MAPS	17
V	CLUSTER ANALYSIS	33
VI	HIERARCHIES	39
VII	PROPOSED CORE JOURNALS	46
VIII	RESULTS AND CONCLUSIONS	55
IX	REFERENCES	61

LIST OF FIGURES

Number		Page
1	Two-Step Map-Making.	17
2	Special Education Graphic Cluster.	19
3	Child Development Graphic Cluster.	20
4	Guidance Graphic Cluster	21
5	Clinical Psychology Graphic Cluster.	22
6	Experimental Psychology Graphic Cluster. . . .	23
7	Educational Psychology and Research Graphic Cluster.	25
8	Elementary Education and Research Graphic Cluster.	26
9	Higher and General Education Graphic Cluster . .	27
10	Science and Science Education Graphic Cluster. .	28
11	All Other Graphic Cluster.	29
12	Two-Step Map of Subfields of Education Journals	31
13	Two-Step Cluster Maps.	38
14	Hierarchy of Graphic Clusters.	40
15	Hierarchy of Cluster Analysis Clusters	41
16	Hierarchy of Journals in Education	42
17	The Relative Size of Categories of Education Journals	54
18	Ratio of Citations To/Citations From by Subfield	57
19	Cross Subfield Citation Patterns	59
20	Citations From Subfields to Included Journals, With and Without Self Citation	59

LIST OF TABLES

Number		Page
1	All Included Journals.	6
2	Journals Investigated and Classified Out of the Field of This Study.	13
3	All Included Journals Ranked by References/ Year	14
4	Excluded Journals with Less Than 100 References Per Year.	15
5	A Portion of the Standard Matrix	33
6	Cluster Analysis Clusters.	35
7	Comparison of Clusters Determined by Two Methods.	37
8	Journal Importance Categorization.	47
9	Psychology Journals.	51

ANALYSIS OF RESEARCH JOURNALS AND RELATED RESEARCH STRUCTURE, IN EDUCATION

I. INTRODUCTION

To expedite the organization, utilization and support of education research it is necessary, as fully as possible, to understand and empirically demonstrate the structure and interrelationships of the many relevant areas of knowledge. The need for such an empirical frame of reference has been pointed out for the research scientists, by Guilford:[1]

> "Any serious investigator, in basic science or in technology, finds a good frame of reference very helpful. A frame of reference may be as broad as a philosophical point of view or as circumscribed as a limited scientific theory... An investigator without focused efforts is likely to pick away at minor problems, here and there, as fancy of the moment dictates or as an opportunity comes his way... A good frame of reference for an investigator's purpose has three important specifications: It should be comprehensive, it should be systematic, and it should be empirically based."

Since the research literature is the fundamental medium for reporting research knowledge, it is reasonable to assume, a priori, that the structure of the literature in a field will reflect the structure of the knowledge in that field.

In a recently completed OE contract,[2] "Analysis of Research Journals, and Related Research Structure, in Special Education," hereafter referred to as the Special Education report, Computer Horizons investigated the structure of the special education research literature, and related it to some of the surrounding general education literature, and the supporting psychology literature. In that study a total of 118 journals were chosen for inclusion in the analysis by progressing from a few key special education journals to the journals heavily cited by the key journals. In turn, the journals cited by the cited journals were surveyed, etc., until the citing chains closed upon journals which were already considered, or were clearly out of the field of interest. Of 79 journals in the final sample 19 were classified as special education, 26 as general education, and 34 as psychology.

It was found that there is a much stronger tie from special education to psychology than from special education to general education. It appears that general education and special education are both dependent on psychology, and relatively independent of one another. The referencing structure of general education is highly dispersed, that of special education seems to be somewhat less highly dispersed, and that of psychology not nearly as dispersed.

Thus the previous study has established the feasibility of using the structure of the special education research literature to gain insight into the structure and importance of research knowledge. This study builds upon the previous one by expanding the data base to include all education areas and journals of general significance. The analysis was also developed further through the extension of the mapping techniques, the automatic identification of core journals, and through journal cluster analysis.

II. BACKGROUND

The study of the scientific literature has been ongoing for more than fifty years. Work has often aimed toward uncovering data useful for science policy purposes; it has also been pursued in response to the esthetic challenge of understanding the scientific mosaic.

One of the first papers based on significant statistical data was Cole and Eales 1917 analysis of the comparative anatomy literature, as it existed from 1550 to 1860.[3] A few years later, in 1923, Hulme published an analysis of the author entries in "The International Catalogue of Scientific Literature."[4]

Both Cole and Eales work, and that of Hulme, were based on publications. The first paper analyzing citations, as opposed to publications, was that of Gross and Gross in Science in 1927.[5] Following Gross and Gross's paper there was a burst of papers, often authored by science librarians, attempting to define the importance and dispersion of various segments of the scientific literature, usually from the viewpoint of specific disciplines or subdisciplines.[6]

After this burst of papers in the early 1930's the field became quiescent, and stayed so through the war years. Bradford's key work in 1934, measuring the spread of papers for a given subject, became the base for much post war research.[7] In the 1950's there was a gradual reemergence of analysis of the literature, as science became large in the 1960's, and the problems of managing a large and rapidly growing enterprise became significant. Evidence for the growing importance of the subject was the appearance of Derek Price's books.[8]

The communications systems of science also became subjects of scholarly study. Cole and Cole looked at the output of journal papers, and scholarly recognition.[9] Crane[10] and Zukerman and Merton[11] looked at the selection of articles for journals, and Garvey[12] and others have looked at the whole range of communications activities in the physical and social sciences.

The inner structure of technical literature also became a subject for scholarly investigation. Xhignesse and Osgood[13] looked at cross citing, and graphical techniques, for the psychology literature. Van Cott and Zavala[14] attempted to factor analyze the physics literature, and Kessler[15] studied citations in the same subject area. Stevens[16] and Hagstrom[17] measured differences between the characteristics of the literature in different fields. Finally, we very recently published a paper on the structure of the special education literature.[18]

Thus there has been extensive work on the size and characteristics of the technical literature. We have gone a step farther, in the research reported here, in analyzing and giving structure to the education literature.

In the next section we describe our methods of data gathering. Subsequent sections summarize our results through mapping, cluster analysis, and identification of core journals and set forth our conclusions based on those results.

III. DATA ACQUISITIONS

The basic data in this report are citations to and from a journal. By citations to a journal A we mean all the individual references to articles in journal A from other journals B, C, D, etc., in our set. Similarly, citations from journal A are all references from articles in journal A to articles in all other journals, books, magazines, newspapers and the like. So, by definition, citations-to refers to journal citations only, while journal citations are only a part of citations-from. Often, however, we will speak of citations to and from the journal set; all citations in that context are journal citations.

We hoped, when adding new journals, to only include journals which contained 500 journal citations within a five year time span; this criterion for scholarliness was established in the Special Education study as a minimum indicator of technical respectability for education journals. In this study we found that a five year span was insufficient to obtain 500 journal citations from most of the education journals covered in the earlier report. Therefore, the standards were relaxed to 500 citations of any kind over five years, or an average of 100 citations per year. Citations were then tabulated until 500 journal citations, or five years of the journal were covered, whichever came first. Table 1 lists all journals included in this study. Note that many psychology journals are included, since they are very heavily cited by education journals.

All of the journals used in the Special Education report were also included in this study, as were all education and special education journals scanned but rejected in the earlier study, which satisfied the more relaxed criteria used here.

New journals were added in other ways. All periodicals cited five times or more by any single journal in our sample were noted and scanned on the criteria above. Any journal so cited that contained the requisite number of citations, and was not out of the field of education, was then included in the sample and those journals it cited five times or more became eligible for the same scrutiny.

A publication was considered to be out of the field of education if it primarily cited books and periodicals in other disciplines. Table 2 lists journals considered to be out of the field of education, in that sense. The two journals referred to most often by a journal in our set received top priority in this phase of data gathering.

TABLE 1

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
Acad Ther	Academic Therapy
Alb J Ed R	Alberta Journal of Educational Research
Am Ann Deaf	American Annals of the Deaf
AAUP Bull	American Association of University Professors Bulletin
Am Bio Te	American Biology Teacher
Am Ed Res J	American Educational Research Journal
Am J M Def	American Journal of Mental Deficiency
Am J Orthop	American Journal of Orthopsychiatry
Am Psych	American Psychologist
Arit Teach	Arithmetic Teacher
Art Educ	Art Education
A V Com Rev	Audiovisual Communications Review
A V Instr	Audiovisual Instruction
Beh Res The	Behaviour Research and Therapy
Br J Ed Psy	British Journal of Educational Psychology
Cal J Ed Res	California Journal of Educational Research
Cath Ed R	Catholic Education Review
Cath Sch J	Catholic School Journal
Child Dev	Child Development
Childh Ed	Childhood Education
Children	Children
Clear Hse	Clearing House

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
Coll Univ	College and University
Comp Ed Rev	Comparative Education Review
Contemp Ed	Contemporary Education
Counsl Ed	Counselor Education and Supervision
Ed Admin Q	Educational Administration Quarterly
Ed Leader	Educational Leadership
Ed Psy Meas	Educational and Psychological Measurement
Ed Theory	Educational Theory
Educ Forum	Educational Forum
Educ Hor	Educational Horizons
Educ Record	Educational Record
Educ Res	Educational Research
Educ Tech	Educational Technology
Education	Education
El Sch Guid	Elementary School Guidance and Counseling
Elem Eng	Elementary English
Elem Sch J	Elementary School Journal
Excpt Child	Exceptional Children
G R Ed R D	Graduate Research in Education and Related Disciplines
Gif Child Q	Gifted Child Quarterly
Harv Ed Rev	Harvard Educational Review
High School	High School Journal
Imp Col U Te	Improving College and University Teaching

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
Int Rev Ed	International Review of Education
Integ Ed	Integrated Education
J Abn Psych	Journal of Abnormal and Social Psychology
J Acoust So	Journal of the Acoustical Society of America
J Am Stat A	Journal of the American Statistical Association
J Appl Beh	Journal of Applied Behavior Analysis
J Appl Psyc	Journal of Applied Psychology
J Clin Psyc	Journal of Clinical Psychology
J Col Pers	Journal of College Student Personnel
J Com Physl	Journal of Comparative and Physiological Psychology
J Cons Clin	Journal of Consulting and Clinical Psychology
J Coun Psyc	Journal of Counseling Psychology
J Creat Beh	Journal of Creative Behavior
J Ed Admin	Journal of Educational Administration
J Educ	Journal of Education
J Educ Meas	Journal of Educational Measurement
J Educ Psyc	Journal of Educational Psychology
J Educ Res	Journal of Educational Research
J Exp Child	Journal of Experimental Child Psychology
J Exp Educ	Journal of Experimental Education
J Exp Psych	Journal of Experimental Psychology
J Gen Ed	Journal of General Education

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
J Higher Ed	Journal of Higher Education
J Learn Dis	Journal of Learning Disabilities
J Ment Def	Journal of Mental Deficiency Research
J NAWDC	Journal of the National Association of Women's Deans and Counselors
J Negro Ed	Journal of Negro Education
J Nerv Ment	Journal of Nervous and Mental Disease
J Pers	Journal of Personality
J R Dev Ed	Journal of Research and Development in Education
J Read Spec	Journal of the Reading Specialist
J Reading	Journal of Reading
J Reh Deaf	Journal of Rehabilitation of the Deaf
J Rehab	Journal of Rehabilitation
J Res Mus Ed	Journal of Research in Music Education
J Res Sci	Journal of Research in Science Teaching
J Sch Heal	Journal of School Health
J Sch Psyc	Journal of School Psychology
J Sec Educ	Journal of Secondary Education
J Soc Psyc	Journal of Social Psychology
J Sp He Di	Journal of Speech and Hearing Disorders
J Sp He Re	Journal of Speech and Hearing Research
J Spec Ed	Journal of Special Education
J Teach Ed	Journal of Teacher Education

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
J Vrb Lrn	Journal of Verbal Learning and Verbal Behavior
Jr Col J	Junior College Journal
Lang Lrn	Language Learning
Liberal Ed	Liberal Education
Math Teach	Mathematics Teacher
Mer Pal Q	Merrill-Palmer Quarterly
Ment Hyg	Mental Hygiene
Ment Ret	Mental Retardation
Mod Lang J	Modern Language Journal
Mus Ed J	Music Educator's Journal
NASSP	National Association of Secondary School Principals Bulletin
Nat Elem Pr	National Elementary Principal
New Outlook	New Outlook for the Blind
Pea J Ed	Peabody Journal of Education
Perc Mot Sk	Perceptual and Motor Skills
Perc Psych	Perception and Psychophysics
Pers Guidan	Personnel and Guidance Journal
Phi Del Kap	Phi Delta Kappan
Psyc School	Psychology in the Schools
Psych Bull	Psychological Bulletin
Psych Repts	Psychological Reports
Psych Rev	Psychological Review
Psychomet	Psychometrika

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
Psychonom S	Psychonomic Science
Q H Ed Neg	Quarterly Review of Higher Education Among Negros
Read Res Q	Reading Research Quarterly
Read Teach	Reading Teacher
Record	Record
Reh Couns B	Rehabilitation Counseling Bulletin
Rel Educ	Religious Education
Res Quart	Research Quarterly
Rev Ed Res	Review of Educational Research
Sch Rev	School Review
Sch Sci Mat	School Science and Mathematics
Sch Soc	School and Society
Sci Child	Science and Children
Sci Educ	Science Education
Sci Teach	Science Teacher
Sightsaving	Sight-Saving Review
Soc of Educ	Sociology of Education
Social Ed	Social Education
Spec Educ	Special Education
St Art Ed	Studies in Art Education
St Phil Ed	Studies in Philosophy and Education
TESOL Q	TESOL Quarterly

TABLE 1 (Continued)

ALL INCLUDED JOURNALS

Abbreviation	Journal Name
Theory Prac	Theory Into Practice
Tran Sch B	Training School Bulletin
Urb Educ	Urban Education
Voc Guid Q	Vocational Guidance Quarterly
Volta Rev	Volta Review
Yng Child	Young Children

TABLE 2

JOURNALS INVESTIGATED AND CLASSIFIED
OUT OF THE FIELD OF THIS STUDY

Journal	Issues/Yr	Refs/Yr
Journal of Chemical Education	12	2400
Journal of Legal Education	5	911
Journal of Medical Education	11	891
History of Education Quarterly	4	825
Hispania	4	536
Speech Teacher	4	436
Journal of Home Economics	10	373
Journal of Dental Education	4	363
Adolescence	4	331
Journal of Education for Librarianship	4	158
College English	8	154
Journal of Business Education	8	119
Industrial Arts and Vocational Education	10	117

The journal set expanded rapidly at first, but just as quickly began to close in on itself as had the journal set in the Special Education report. In the end, we found fewer and fewer journals of wide circulation with more than our minimum number of citations, 100 per year, that could be called education journals. In this later stage most journals scanned were either out of the field or little more than glorified trade journals.

Finally, to insure that we had not missed any important journal in the field of education we consulted Camp's Guide to Periodicals in Education.[19] Any journal listed there as relating primarily to education, not already covered, was scanned and included if it had at least 100 citations to journals or books per year, and a reasonably wide circulation. Table 3 lists all the journals in our sample, ranked by number of citations per year.

Note that there are a few journals that are close to the cutoff point of 100 citations per year. Sightsaving Review was included in this study, although it did not strictly meet the criteria, because it was included in the previous study.

A list of those journals we investigated carefully but which did not satisfy our criteria, may be found in Table 4.

TABLE 3

ALL INCLUDED JOURNALS RANKED BY REFERENCES/YEAR

Journal	No. Refs.	Journal	No. Refs.	Journal	No. Refs.
J Exp Psych	4500	Phi Del Kap	555	Art Educ	255
J Com Physl	4320	J Exp Educ	552	St Phil Ed	251
Psych Rep	4000	J Res Sci	552	Education	250
Psychon Sci	3684	J Col Pers	549	NASSP Bull	244
J Abn Psych	3627	Rel Educ	539	J Reading	242
Perc Mot Sk	3500	Read Teach	536	Childh Ed	239
Rev Ed Res	2780	Pers Guidan	531	Nat El Prin	239
Psych Bull	2205	J Ment Def	525	Tran Sch B	237
Perc Psych	1965	J Learn Dis	509	Acad Ther	232
J Spec Ed	1942	Ed Psy Meas	506	G R Ed R D	230
J Cons Clin	1650	Ed Res J	500	Clear Hse	228
Am J Me Def	1500	Cath Sch J	468	Ed Sch Guid	226
J Vrb Lrn	1498	J R Dev Ed	457	Am Ann Deaf	221
J Couns Psy	1317	Am Bio Te	450	J Read Spec	219
J Exp Child	1300	Soc of Ed	444	Cal J Ed Re	216
J Am Stat A	1272	Sch Sci Mat	435	Contemp Ed	215
Am Psych	1264	A-V Com Rev	431	Mus Ed J	209
Am J Orthop	1250	Educ Tech	430	Urb Educ	208
Br J Ed Psy	1113	Elem Sch J	424	Yng Child	206
J Soc Psyc	1090	Arit Teach	419	J Ed Admin	205
J Nerv Ment	1084	Read Res Qu	408	Gift Child	205
J Sp He Re	1075	Record	404	Col Univ	204
J Ed Psyc	1051	J Teach Ed	400	Pea J Ed	203
Child Dev	1000	Comp Ed Rev	400	Educ Rec	197
Res Quart	991	J Appl Beh	393	Reh Couns B	196
Elem Eng	953	J Sp He Di	392	J Reh Deaf	195
Psych Rev	944	Sci Teach	391	J Sec Ed	188
J Appl Psyc	895	Math Teach	381	Lang Lrn	183
J Clin Psyc	843	Imp Col U Te	371	AAUP Bull	174
Sch Rev	820	Har Ed Rev	354	J NAWDC	174
Mer-Pal Qu	810	Voc Guid Q	339	Stud Art Ed	167
J Ed Res	800	J Creat Beh	332	A V Instr	165
J Pers	791	Mod Lang J	320	Children	160
Beh Reh The	720	Alb J Ed Re	320	J Gen Ed	156
J Negro Ed	719	Ed Leader	318	Educ Hor	153
Excep Child	715	Volta Rev	312	New-Outlook	150
Ed Theory	691	Theory Prac	304	Jr Col J	149
Psyc School	672	High School	300	J Higher Ed	146
Ment Hyg	629	Sch Soc	298	Integ Educ	144
J Acous Soc	600	Counsl Ed	292	Lib Educ	143
J Sch Heal	584	J Educ Meas	288	Sci Child	141
Psychomat	581	J Educ	285	J Rehab	138
Social Ed	572	Ed Admin Q	272	TESOL Qu	128
Ment Ret	564	J Re Mus Ed	271	Int Rev Ed	103
Sci Ed	559	H Ed Negro	265	Spec Ed	102
Cath Ed Rev	557	Educ Res	258	Sightsaving	75
J Sch Psyc	555	Educ Forum	255		

TABLE 4

EXCLUDED JOURNALS WITH LESS THAN
100 REFERENCES PER YEAR

Journal	Issues/Yr	Refs/Yr
American Education	10	0
American School and University	12	0
American School Board Journal	12	0
Arts and Activities	10	0
Bulletin on International Education	10	0
College and University Bulletin	14	0
College and University Business	12	0
Educational Digest	9	0
Educational Panorama	4	0
Grade Teacher	9	0
School and Community	9	0
School Arts Magazine	10	0
American Teacher Magazine	4	1
Journal of American Indian Education	3	6
NEA Journal	9	8
Home Study Review	4	15
Instructor	10	16
Adult Education	4	18
Adult Jewish Education	1	19
National Catholic Educational Administrators Bulletin	4	24
School Activities	9	27
University College Quarterly	4	30
Educational Screen and AV Guide	12	31
NEA Research Bulletin	4	37
School Shop	10	39
Lutheran Education	9	47
Educational Perspective	4	59
Reading Improvement	3	59
Nation's Schools	12	60
College and University Journal	4	75
American Vocational Journal	10	86
Independent Schools Bulletin	4	87
American Music Teacher	6	89

Though all of the periodicals in Table 4 are cited by journals in our sample, some of them more than five times by a single journal, not one of them gives 100 citations per year and so none were included in our sample. Numerous other journals were rejected, informally, because they were of very limited circulation (such as most state education journals) or obviously did not meet the subject or referencing criteria.

The citation data for all of the new journals was hand gathered from the journals as they were found in the University of Chicago Library system. The issues covered were within the time period, 1965-1969, and varied from as high as 40 for the Junior College Journal to as few as six for the Merrill-Palmer Quarterly. The raw data from the Special Education report was reanalyzed to maintain a consistent data base for the entire 140 journal sample, since citations to the newly added journals had to be included in the analysis.

IV. TWO-STEP MAPS

The citation data was used to construct a two-step map of the journal structure in the field of education. Figure 1 illustrates how two-step maps are built. If journal A cites journals B and C more often than any other journal, then journals B and C receive arrows from journal A. Self citation is not included; that is, a journal cannot receive an arrow from itself. B, in turn, gives arrows to C and D, while C gives them to A and E. By connecting these arrows for the entire journal set so as to minimize crossing arrows, a map of a field is obtained. As Figures 2 to 11 show, once this is done similar journals group themselves together.

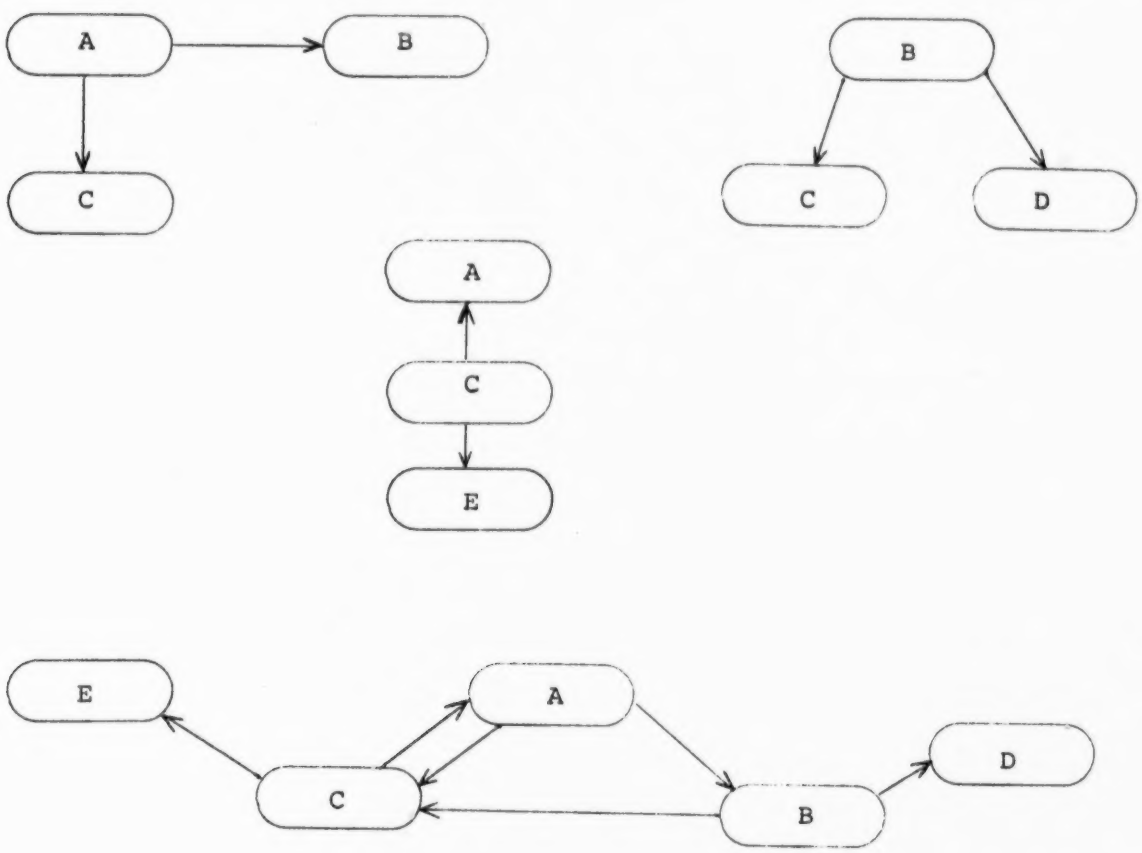


FIGURE 1 - TWO-STEP MAP-MAKING

Journals grouped themselves together around general topics so well that we will refer to the groups as graphic clusters.

Figure 2 then shows a cluster of special education journals, and clearly pinpoints the importance of the American Journal of Mental Deficiency and Exceptional Children. Subgroupings of journals related to speech and hearing can be seen toward the lower center of the figure. Journal names in parentheses are journals not included in the sample. Journal names not enclosed are journals included in other graphic clusters. Note that most of the off map journals receiving arrows are psychology and/or medical journals - demonstrating the importance of these fields to special education.

The child development cluster, Figure 3, is named for its most important journal, Child Development. Its links to psychology are apparent in the arrows it gives to psychology journals. Despite giving nearly half of its arrows to journals outside of its cluster it clearly has a centrally focused structure.

Guidance, Figure 4, has an interesting three-leveled structure. The Personnel and Guidance Journal is firmly at its core but just as firmly underlying it is the Journal of Counseling Psychology. Loosely lying on top of this structure is a group of lightweight education journals with Phi Delta Kappan at their center. The internal structure of this graphic cluster is very similar to that of education as a whole.

Figure 5, the clinical psychology graphic cluster, has one center, the Journal of Abnormal and Social Psychology. That journal is one of the most important in our journal set as is obvious from the number of arrows leading to it. Yet there are three distinct sub-groups to be found in the upper right, lower right, and lower left sections of this map. On the left is a set of layman-oriented journals; American Psychologist is the most well known of these. On the lower right is a group of mathematics oriented "measurement" journals. This subgroup links clinical psychology to bordering mathematical areas. The journals on the upper right of the cluster are aimed more at the practicing psychologist.

Experimental psychology is the most self contained of all the graphic clusters of journals. Figure 6 shows that seven of the eight journals in the group give an arrow to the cluster's central journal, the Journal of Experimental Psychology, and only four arrows are not given to journals in the cluster. Three of those four go to journals not covered in this study because they are not education oriented journals, and the other goes to the Journal of Abnormal and Social Psychology. Yet 2-1/2 times that number of arrows are given to this cluster by other journals in our set.

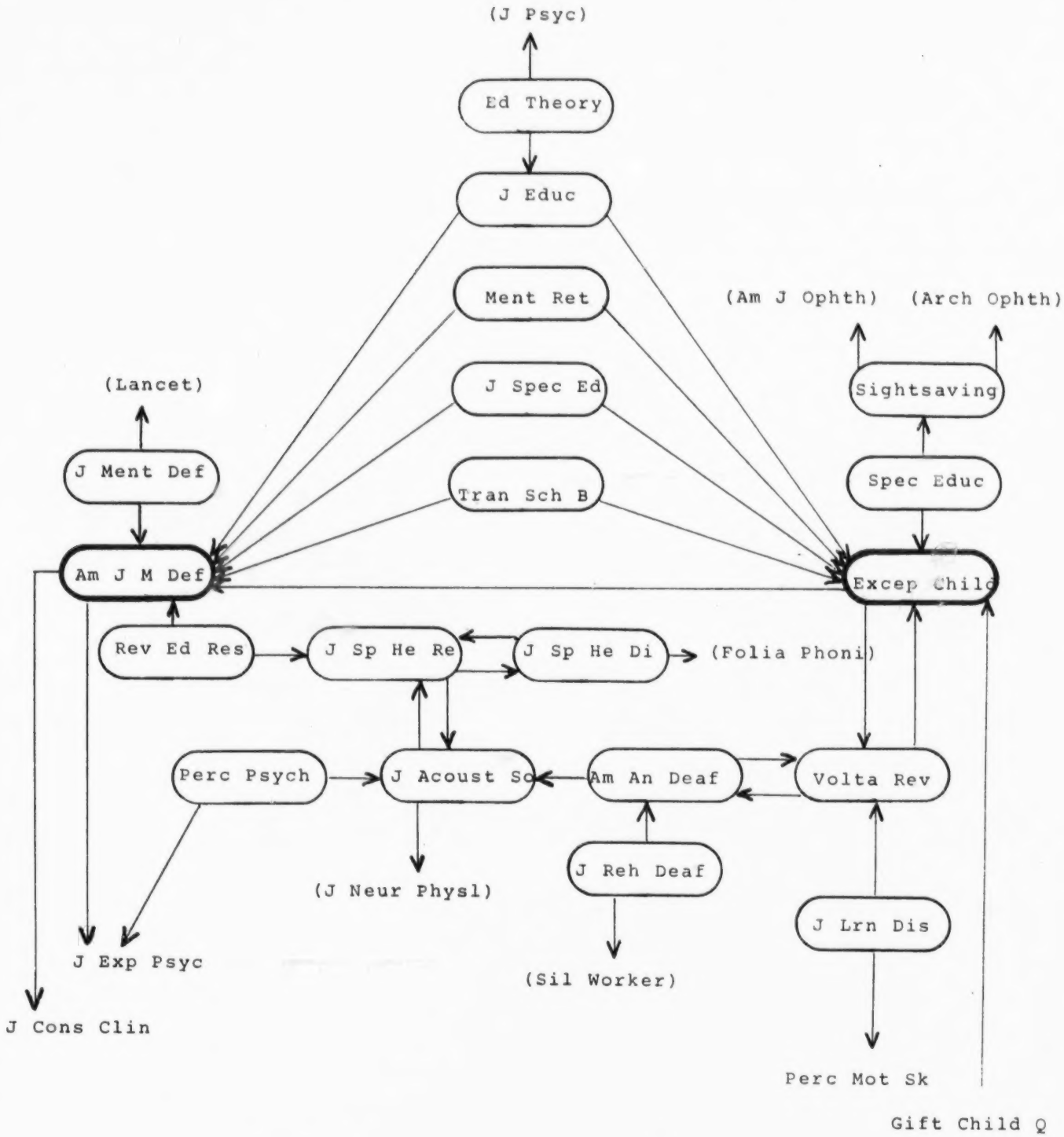


FIGURE 2 - SPECIAL EDUCATION GRAPHIC CLUSTER

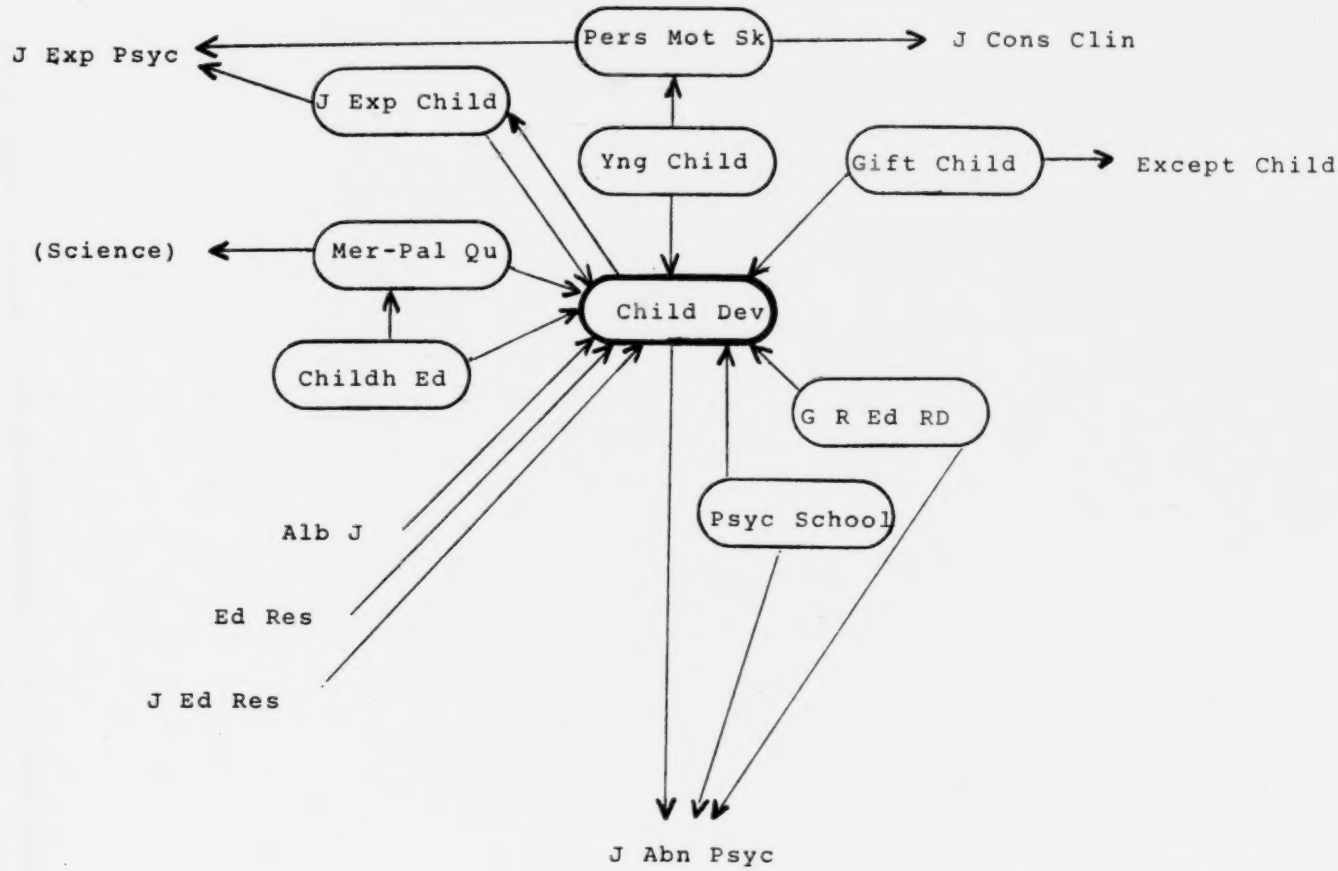


FIGURE 3 - CHILD DEVELOPMENT GRAPHIC CLUSTER

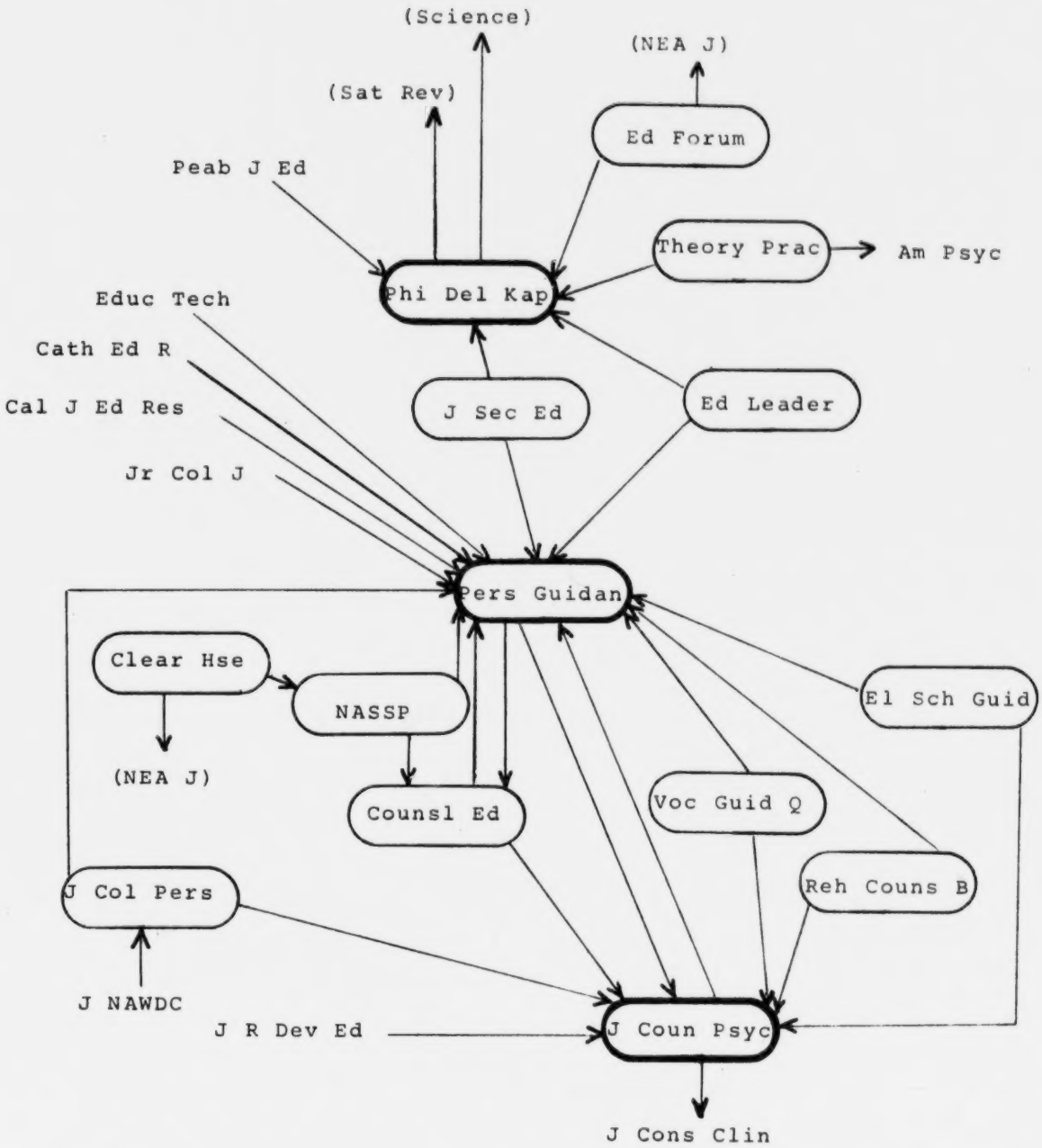


FIGURE 4 - GUIDANCE GRAPHIC CLUSTER

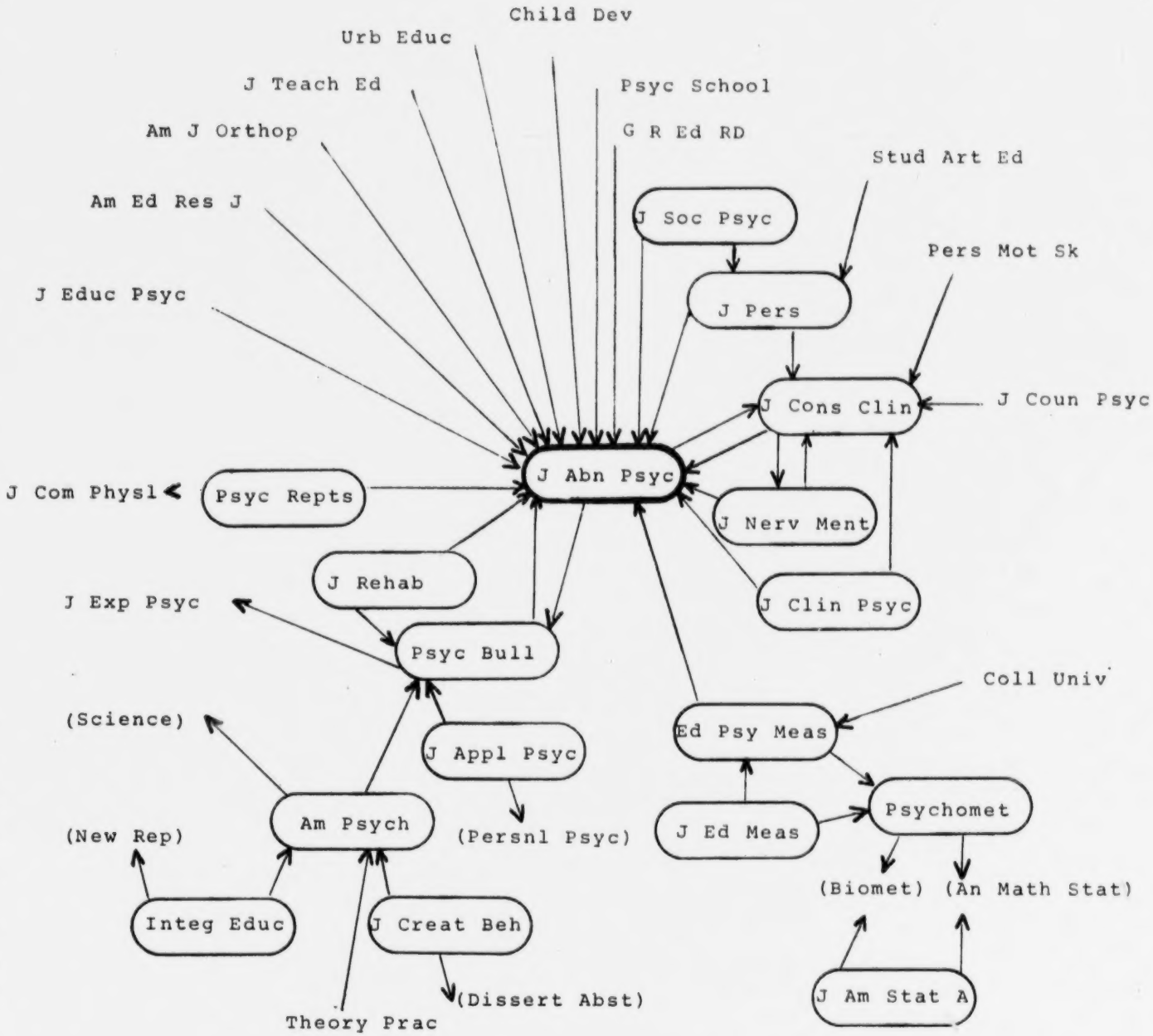


FIGURE 5 - CLINICAL PSYCHOLOGY GRAPHIC CLUSTER

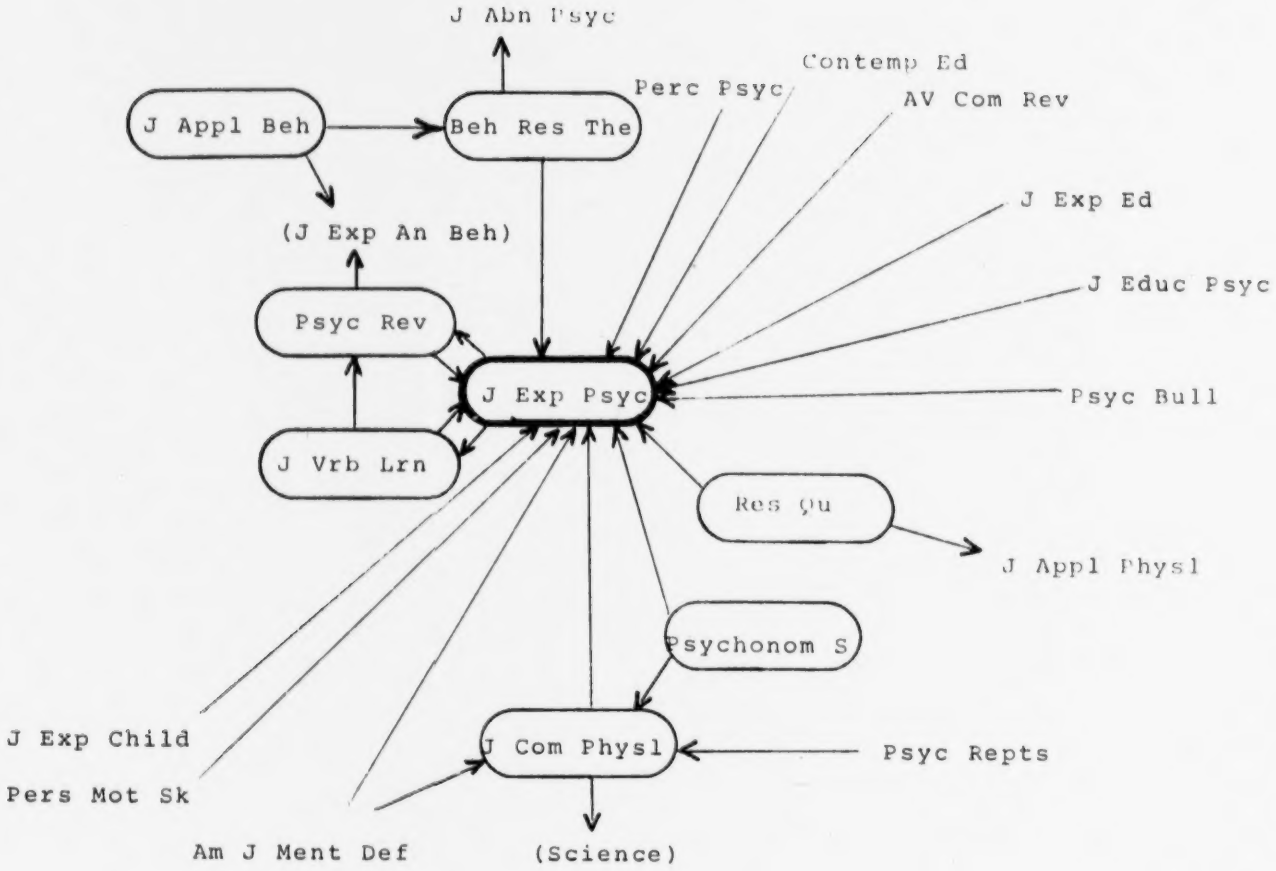


FIGURE 6 - EXPERIMENTAL PSYCHOLOGY GRAPHIC CLUSTER

Educational psychology, Figure 7, is a cluster with a single dominant journal, the Journal of Educational Psychology, which gives this graphic cluster its central focus. In addition it has two subgroups linking it to other lines of thought. In the upper right corner of Figure 7 are a number of journals linking educational psychology with special education and clinical psychology while other journals in the lower section of Figure 7 provide links to the social sciences and guidance.

The graphic cluster labeled elementary education and research, Figure 8, shows a surprisingly coherent internal structure with the research element sitting below those journals devoted primarily to elementary education. Only three arrows are to journals outside of our sample and two of those go well out of education while the other is to a widely used trade journal, the NEA Journal, that we scanned, but found to have far too few citations to be included in our journal set. Because the NEA Journal was cited so often by journals in this cluster it was nonetheless considered part of the cluster for mapping purposes and therefore receives, for the cluster, two arrows from other graphic clusters.

Higher and general education is the most dispersed of all our graphic clusters. As Figure 9 shows it has three major epicenters and one minor one. The minor, and one of the major centers are journals that are not part of our sample because they cannot be considered educational journals. Despite their lack of close contact with each other, each subgroup is itself fairly well defined; that is particularly true of the higher education subgroup. Yet were it not for single links, each of these centers might be considered a separate cluster.

Figure 10, science and science education, is an essentially self contained cluster, with only one arrow leading out to another graphic cluster. Yet the cluster's central journal, Science, is not an education journal, but a journal of diverse topics with articles of general interest, as well as biochemistry and space sciences. Science, not the other journals in the cluster, is the recipient of all the arrows to the cluster. Science is no less an integral part of that cluster for not being an education journal; however the central position of another journal, School Science and Mathematics, more than makes up for that deficiency.

The last graphic cluster, Figure 11, shows small groups of journals in rather specialized areas.

A further organizational step may be made by constructing a two step group map, composed of boxes representing each of the major groups of journals in Figures 2 through 10. In the group map the only arrows shown are those from journals in one group to journals in another group. All arrows to and from journals within a single group are removed. Thus the map shows the relationship between groups.

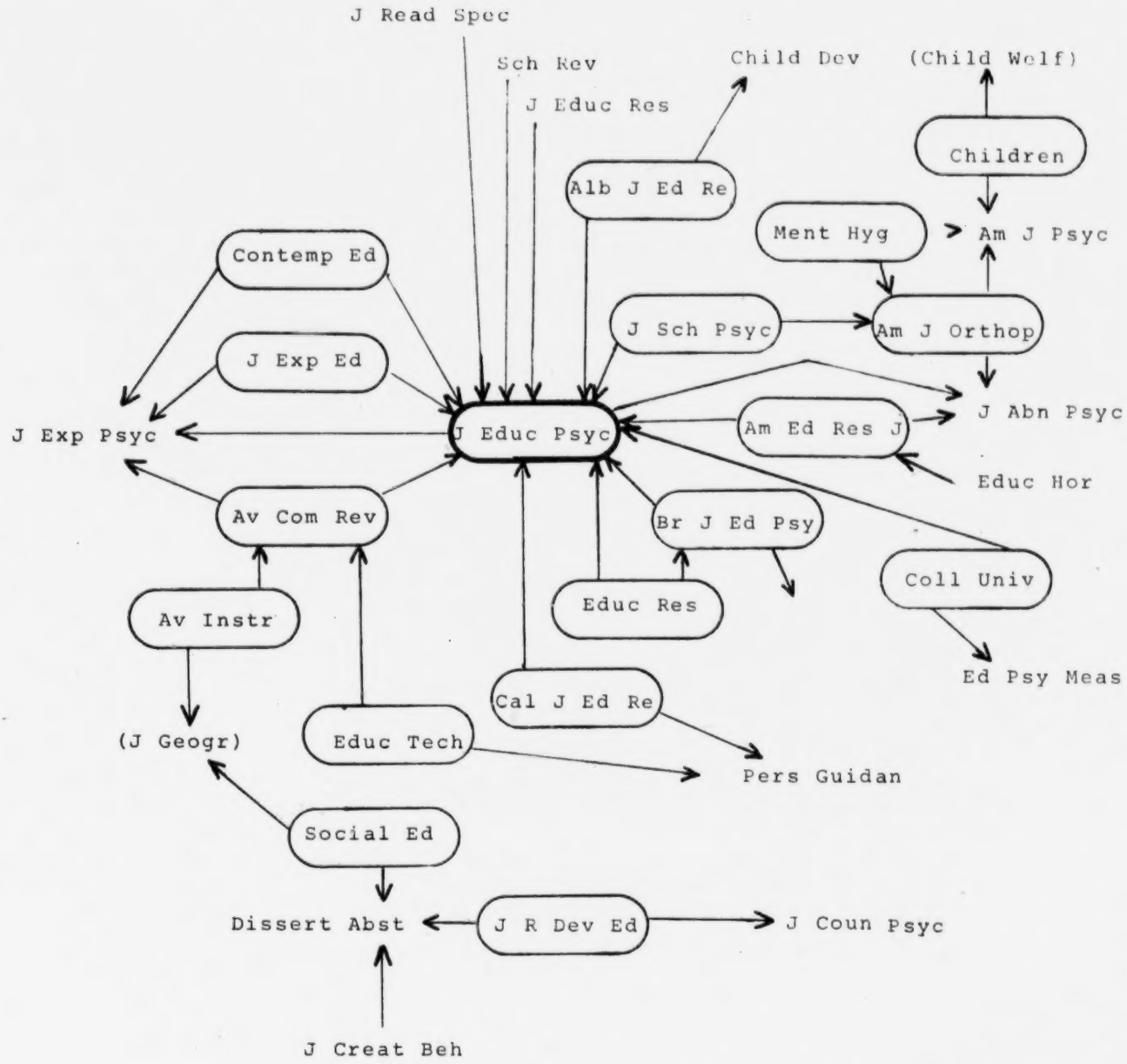


FIGURE 7 - EDUCATIONAL PSYCHOLOGY AND RESEARCH GRAPHIC CLUSTER

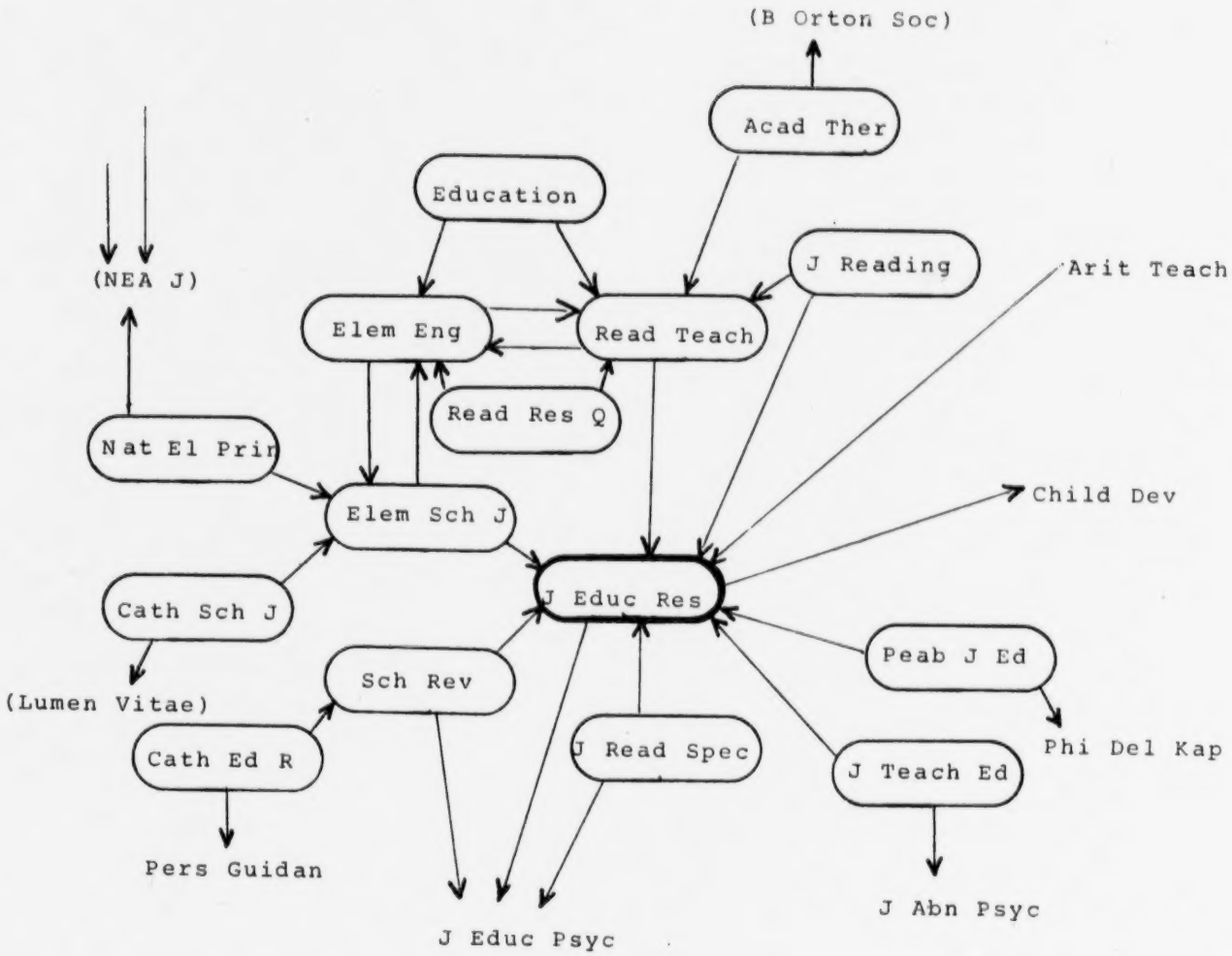


FIGURE 8 - ELEMENTARY EDUCATION AND RESEARCH GRAPHIC CLUSTER

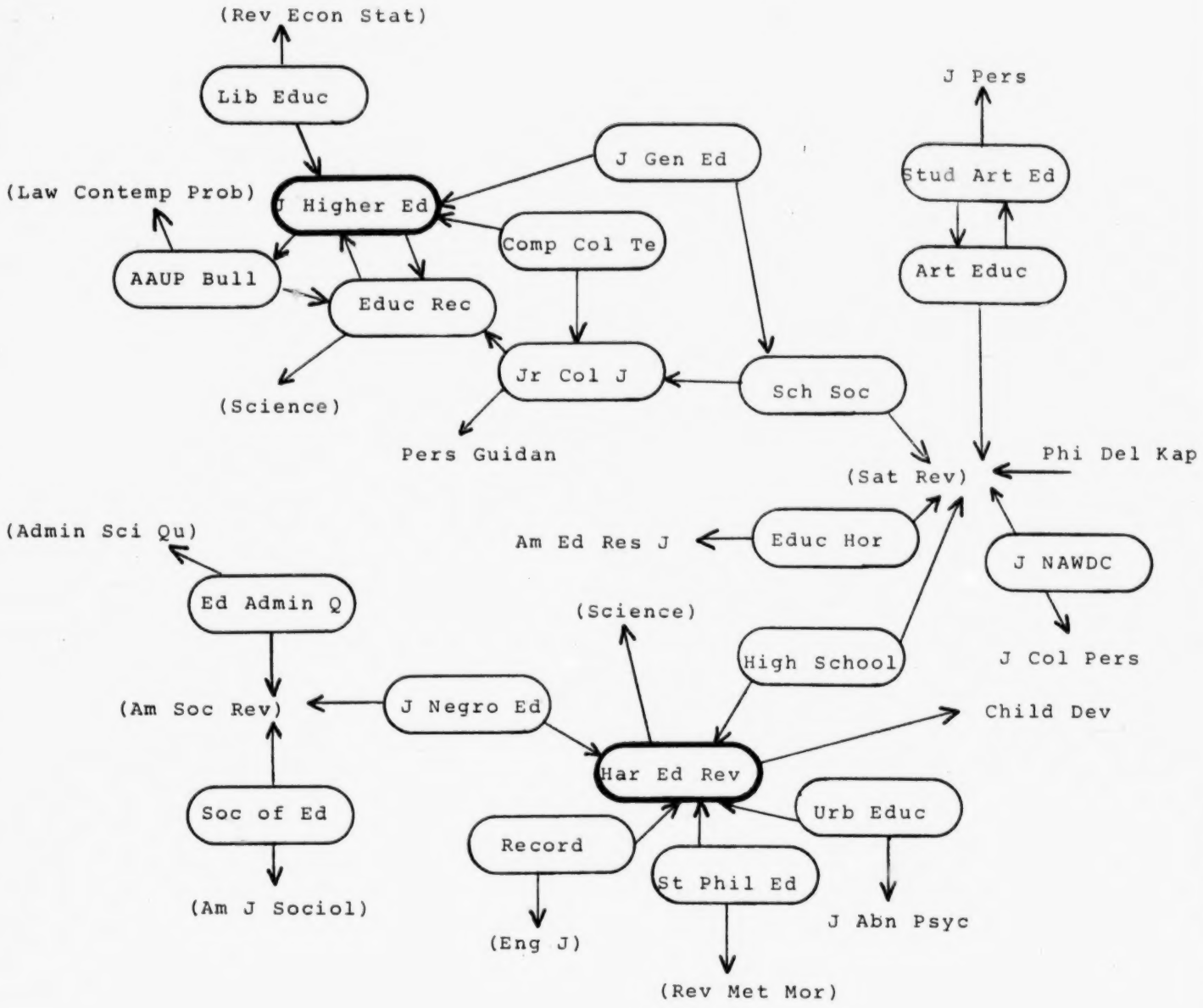


FIGURE 9 - HIGHER AND GENERAL EDUCATION GRAPHIC CLUSTER

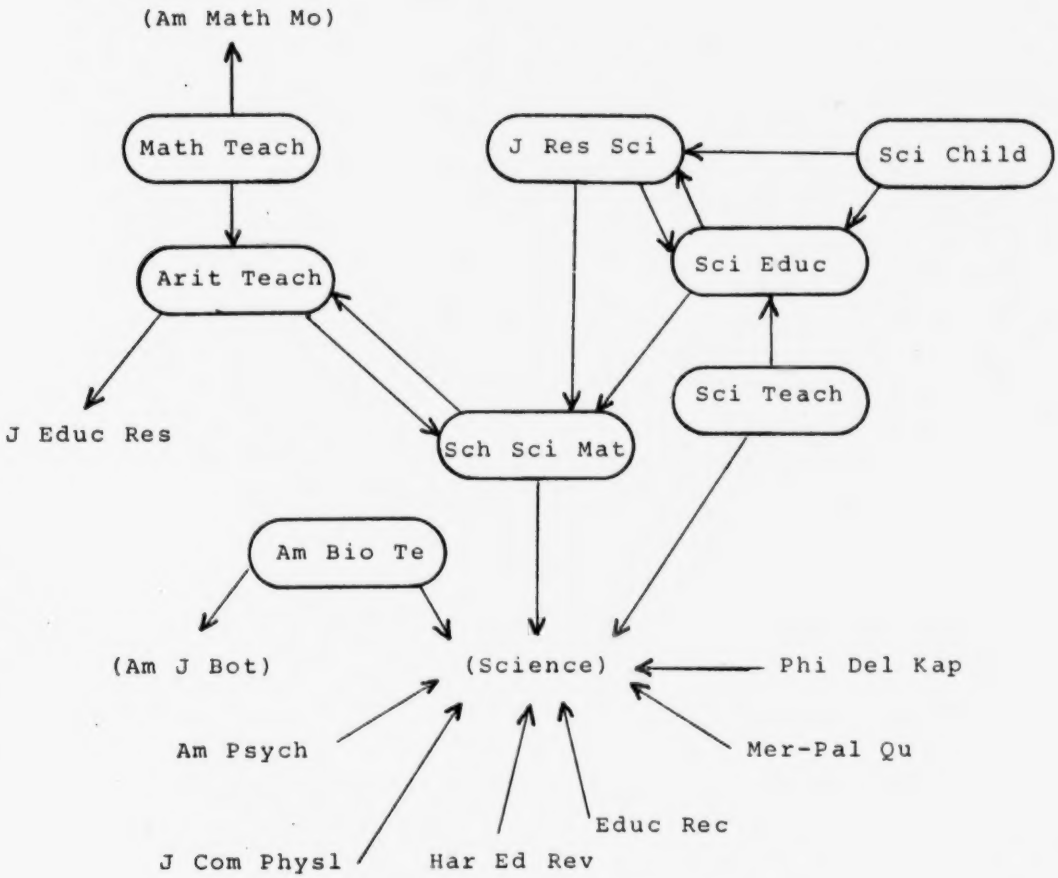


FIGURE 10 - SCIENCE AND SCIENCE EDUCATION GRAPHIC CLUSTER

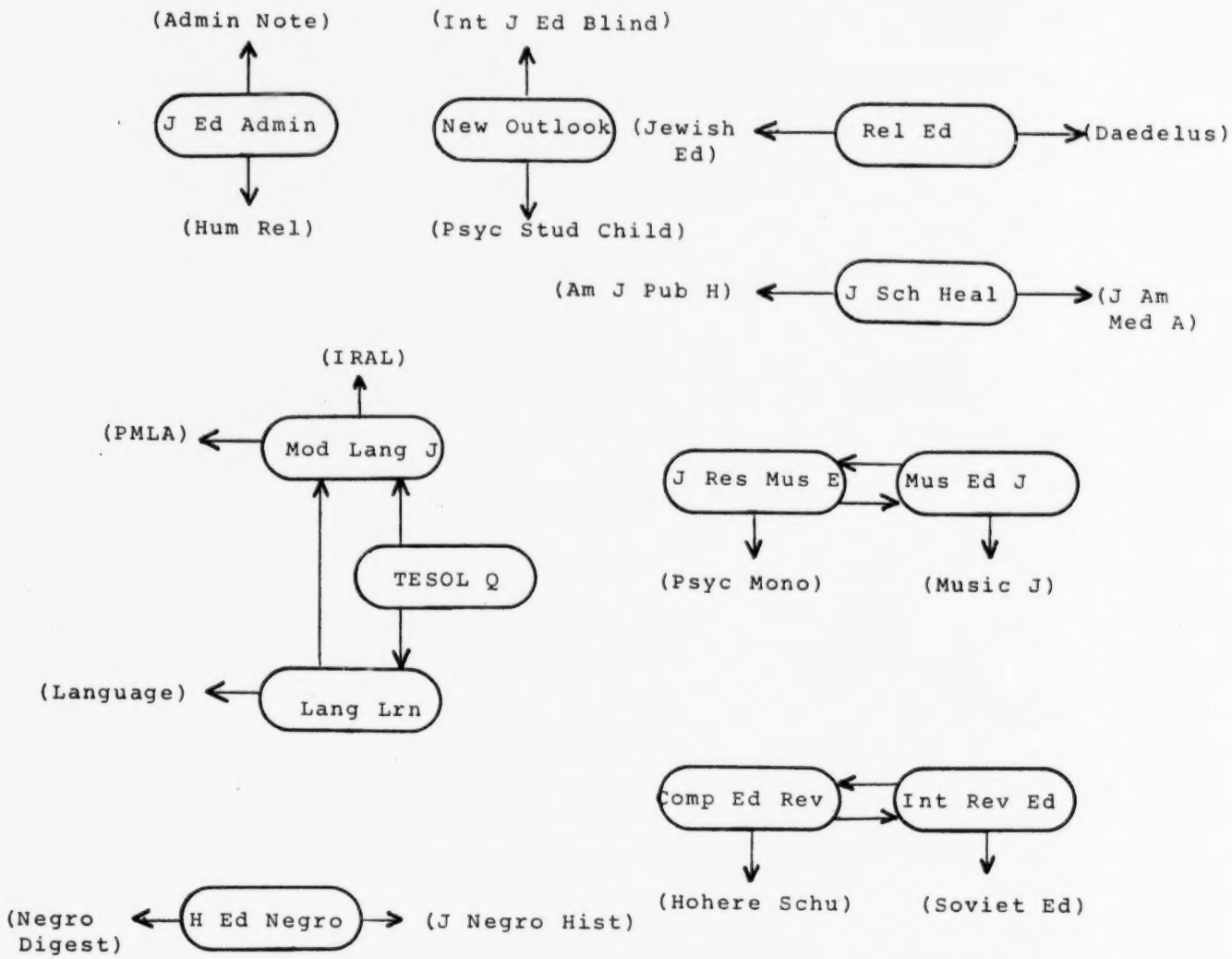


FIGURE 1 - ALL OTHER GRAPHIC CLUSTER

Figure 12, the frontispiece, is such a group map. A remarkably well structured picture of the field of education is drawn. Note that in Figure 12 the direction of the arrows is generally down, towards clinical and experimental psychology. This indicates that journals in educational psychology, child development, and the other graphic clusters cite psychology journals far more often than they cite journals in those clusters. This suggests that the structure of research in education is based on psychology and information in education is drawn from that base.

Of the 256 arrows from the 128* journals on the group two-step map only one-fifth lead out of their clusters into other clusters. This shows how well structured and closed the clusters of journals are. Further, nearly half, 24 of 51, of those arrows lead into clinical and experimental psychology, reemphasizing the primacy of psychology in education.

Of the other clusters the science and science education cluster is particularly self sufficient, perhaps because it has its own body of research in the sciences upon which it can draw.

Two other graphic clusters, special education and higher and general education, have only one arrow given to them, suggesting that they are not widely used by other education groups. The internal structure of the subfields clarifies that point. Essentially, special education, as a well ordered subfield, closes primarily on its own members. Higher and general education, with its multipoler internal structure, may serve as a link between education and the social sciences and humanities, and consequently only as a secondary source of data for education.

Elementary education and research interacts heavily with guidance but has a one-way dependency upon educational psychology and research. The educational psychology and research cluster is the central link for elementary education, child development, guidance, and experimental and clinical psychology, serving as a primary source of information for elementary education, and gathering information from the rest. Guidance is a well-structured bridge between much of educational research and psychology, as its central position in the model demonstrates.

*The twelve journals in the all other map, Figure 11, are not included on the group map because they are so specialized they give no 1st or 2nd arrows to other journals in our set.

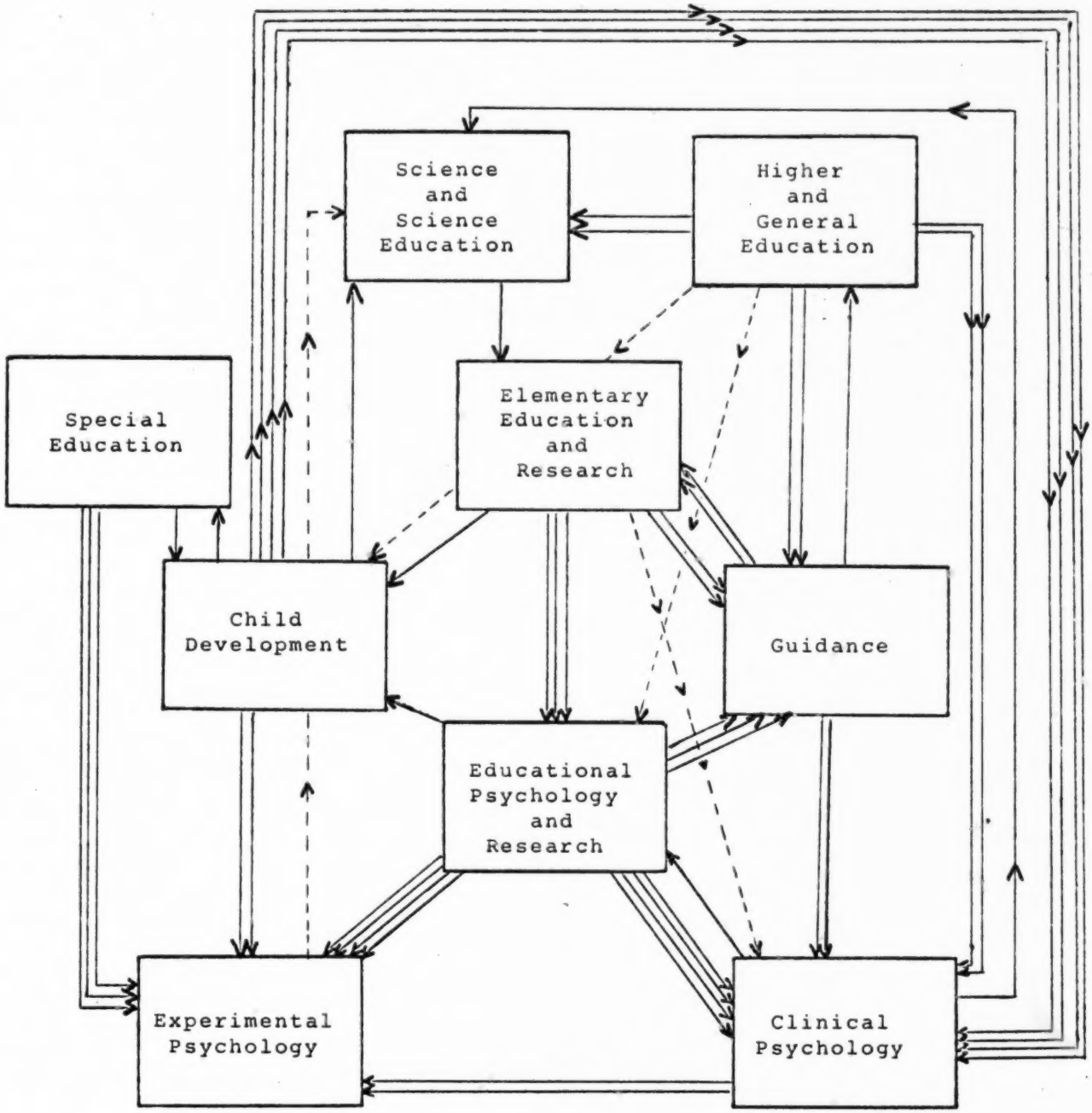


FIGURE 12 - TWO-STEP MAP OF SUBFIELDS OF EDUCATION JOURNALS

Child development serves as a conduit connecting other journals and their clusters to clinical psychology. In turn, clinical psychology is the recipient of most of education's references to psychology, and itself refers directly to experimental psychology. Only special education, child development, and educational psychology of the other graphic clusters refer directly to experimental psychology.

V. CLUSTER ANALYSIS

While the two step maps reveal much about the structure of the education literature, they make use of only a fraction of the available data, since they utilize only the citations to the first and second most frequently cited journals. To overcome this limitation a rather complex cluster analysis procedure has been developed for generating clusters of journals, based on all of the citations to and from each journal.[20] In essence the cluster analysis groups together journals which both highly cite each other and resemble each other in their citing patterns to other journals.

Our general approach to the cluster analysis was that of partitioning the journals into a set of clusters on the basis of a similarity measure and then checking that each journal is in the best cluster by performing hill-climbing passes on the clusters until a measure of the quality of the clusters was optimized.

The basic data for the cluster analysis was a 140 x 140 matrix containing the percentages of references each journal gave to every other journal in the set. Table 5 shows a portion of the matrix.

TABLE 5

A PORTION OF THE STANDARD MATRIX

From \ To	Acad Ther	Am An Deaf	Am Ed Res J	Am J M Def	Am J Orthop	Am Psych	Beh Res The	Br J Ed Psy	Child Dev
Acad Ther	-	-	-	0.85	2.56	-	-	-	1.70
Am An Deaf	-	15.40	-	2.03	-	1.45	-		-
Am Ed Res J	-	-	7.92	-	-	1.10	-	0.22	1.76
Am J M Def	-	-	-	31.60	0.80	0.60	0.20	0.20	1.20
Am J Orthop	-	-	-	0.39	9.58	0.78	0.19	-	2.73
Am Psych	-	-	0.21	-	-	31.26	0.42	-	0.42
Beh Res The	-	-	-	-	0.60	1.20	24.29	-	0.60
Br J Ed Psy	-	0.40	-	0.81	0.60	1.01	-	19.30	3.65
Child Dev	-	-	-	-	0.59	1.57	-	-	18.14

Basically two types of similarity measures were tried:

1. Euclidean distance measures, in which the percents of citations from journal to journal were the data, and

2. Rank correlation measures, in which the rank orders of most cited journals were the data.

For the measure of quality of clustering, several were tried, some based on the various similarity measures and some based on the original data. Various combinations of similarity measures and clustering quality measures were tried, all giving somewhat different results. Most gave quite reasonable clusters but no method was outstanding and no absolute measure of the quality of the final clusters could be chosen. The assumption was then made that the final clusters would be constructed from journals which cluster together on several of the methods. For a more complete discussion of the cluster analysis method the reader is referred to a paper we are now writing on the subject.[21]

Table 6 shows the clusters of education journals derived by the cluster analysis.

Note how easy it was to label the clusters. In fact, the similarities between this cluster analysis, and the graphic clusters are so great that comparison of the graphic clusters with similar groups of these clusters reveal 108 common journals. Seventy-seven percent of the 140 journals in our sample are grouped similarly by two different methods. Table 7 shows two examples.

Another important result of the cluster analysis is a cluster cross-referencing matrix, which shows the patterns of citation by clusters, rather than by individual journals. Figure 13-A is a two-step map made from the cluster cross-referencing matrix for the graphic clusters.* Figure 13-B is a similar map constructed from the cluster analysis cross-referencing matrix. Solid arrows show the most frequently cited clusters, dotted the next most frequently. A comparison of the maps shows the strong similarity between the graphic clusters and the cluster analysis clusters in their pattern of cross cluster citation.

So here again it is apparent that the field of education is well structured, and that the structure is easily discerned through examination of the patterns of journal cross referencing.

*Note Educational Psychology and Child Development receive an equal percentage of citations from Clinical Psychology so both are given second arrows by it. Educational Psychology gives second arrows to both Experimental Psychology and Elementary Education for the same reason.

TABLE 6

CLUSTER ANALYSIS CLUSTERS

Special Education - Speech, Hearing Sight Cluster
- Am Ann Deaf
- J Reh Deaf
- Spec Ed
- Volta Rev
- J Acoust So
- Sightsaving

Educational Psychology and Measurement Cluster
- Am Ed Res J
- Ed Phy Meas
- J Educ Meas
- J Educ Psyc
- J Exp Educ
- Psychomet
- Cal J Ed Res
- J Am Stat A
- J R Dev Ed
- Alb J Ed R
- Theory Prac

Special Education - Mental Abilities Cluster
- Am J M Def
- Ment Ret
- Train Sch B
- Excep Child
- Gif Child Q
- J Educ
- J Ment Def
- J Spec Ed
- Rev Ed Res

Special Education - Physical Handicaps Cluster
- Am J Orthop
- J Learn Dis
- Children
- J Sch Heal
- Ment Hyg
- New Outlook
- G R Ed R D

Applied Psychology Cluster
- Am Psych
- J Appl Psyc
- J NAWDC
- Contemp Ed
- J Creat Beh

Educational Psychology Cluster
- Br J Ed Psy
- Educ Res

Clinical Psychology and Child Development Cluster
- Child Dev
- J Exp Child
- Yng Child
- Mer-Par Qu
- J Com Physl
- J Exp Psyc
- J Vrb Lrn
- Perc Psyc
- Psyc Rev
- Psychonom S
- Beh Res The
- J Abn Psyc
- J Appl Beh
- J Clin Psyc
- J Cons Clin
- J Nerv Ment
- J Pers
- J Soc Psyc
- Perc Mot Sk
- Psyc Repts
- Psyc Bull
- Res Quart

International Education Cluster
- Comp Ed Rev
- Int Rev Ed

Counseling and Guidance Cluster
- Counsl Ed
- J Coun Psyc
- Pers Guidan
- El Sch Guida
- Voc Guid Q
- J Col Pers

Theory of Education Cluster
- Har Ed Rev
- St Phil Ed
- Social Ed
- Ed Theory
- Urb Educ

Reading and Elementary Level Education Cluster
- J Reading
- Education
- Elem Sch J
- Elem Eng
- Read Res Q
- Read Teach
- J Read Spec
- Acad Ther
- J Educ Res
- Cath Sch J

Rehabilitation Cluster
- J Rehab
- Reh Couns B

Science Education Cluster
- J Res Sci
- Sci Educ
- Sci Child
- Sci Teach
- Sch Sci Mat
- Am Bio Te

Speech-Hearing Cluster
- J Sp He Di
- J Sp He Re

TABLE 6 (Continued)

CLUSTER ANALYSIS CLUSTERS

School Psychology Cluster	Math Education Cluster
J Sch Psyc	Math Teach
Psyc School	Arit Teach
Audio-Visual Aids Cluster	Higher Education, Educational Administration, Sociology Cluster
A V Com Rev	Rel Educ
A V Instr	Cath Ed R
Educ Tech	Sch Rev
Music Education Cluster	Soc of Ed
J Res Mus Ed	Integ Educ
Mus Ed J	J Negro Ed
Art Education Cluster	Sch Soc
Art Educ	Educ Rec
Stud Art Ed	J Higher Ed
Secondary Education Cluster	J Gen Ed
NASSP	Imp Col U Te
High School	Lib Educ
Educ Forum	Jr Col J
Pea J Ed	AAUP Bull
J Sec Ed	Coll Univ
Record	J Ed Admin
Educ Hor	Ed Admin Q
Clear Hse	Unclustered
Ed Leader	Nat El Prin
Phi Del Kap	Childh Ed
J Teach Ed	H Ed Negro
Language Education Cluster	
TESOL Qu	
Lang Lrn	
Mod Lang J	

TABLE 7

COMPARISON OF CLUSTERS DETERMINED BY TWO METHODS*

Graphic	Cluster Analysis	Common	Graphic	Cluster Analysis	Common
Am An Deaf	Am An Deaf	Am An Deaf	Clear Hse	Counsl Ed	Counsl Ed
Am J M Def	J Acoust So	J Acoust So	Counsl Ed	El Sch Guid	El Sch Guid
Ed Theory	J Reh Deaf	J Reh Deaf	Ed Forum	J Col Pers	J Col Pers
Excep Child	Spec Ed	Spec Ed	Ed Leader	J Coun Psyc	J Coun Psyc
J Acoust So	Sightsaving	Sightsaving	El Sch Guid	Pers Guidan	Pers Guidan
J Educ	Volta Rev	Volta Rev	J Col Pers	Voc Guid Q	Voc Guid Q
J Lrn Dis			J Coun Psyc		
J Ment Def	Am J M Def	Am J M Def	J Soc Ed	J Rehab	Reh Couns B
J Reh Deaf	Excep Child	Excep Child	NASSP	Reh Couns B	
J Sp He Di	Gift Chid Q	J Educ	Pers Guidan		
J Sp He Re	J Educ	J Ment Def	Phi Del Kap	Clear Hse	Clear Hse
J Spec Ed	J Ment Def	J Spec Ed	Reh Couns B	Ed Forum	Ed Forum
Ment Ret	J Spec Ed	Ment Ret	Theory Prac	Ed Leader	Ed Leader
Perc Psych	Ment Ret	Rev Ed Res	Voc Guid Q	Educ Hor	J Sec Ed
Sightsaving	Rev Ed Res	Tran Sch B		High School	NASSP
Spec Ed	Tran Sch B			J Sec Ed	Phi Del Kap
Tran Sch B				J Teach Ed	
Volta Rev	J Sp He Di	J Sp He Di		NASSP	
	J Sp He Re	J Sp He Re		Pea J Ed	
				Phi Del Kap	
				Record	

*In each case one graphic cluster is compared to three cluster analysis clusters.

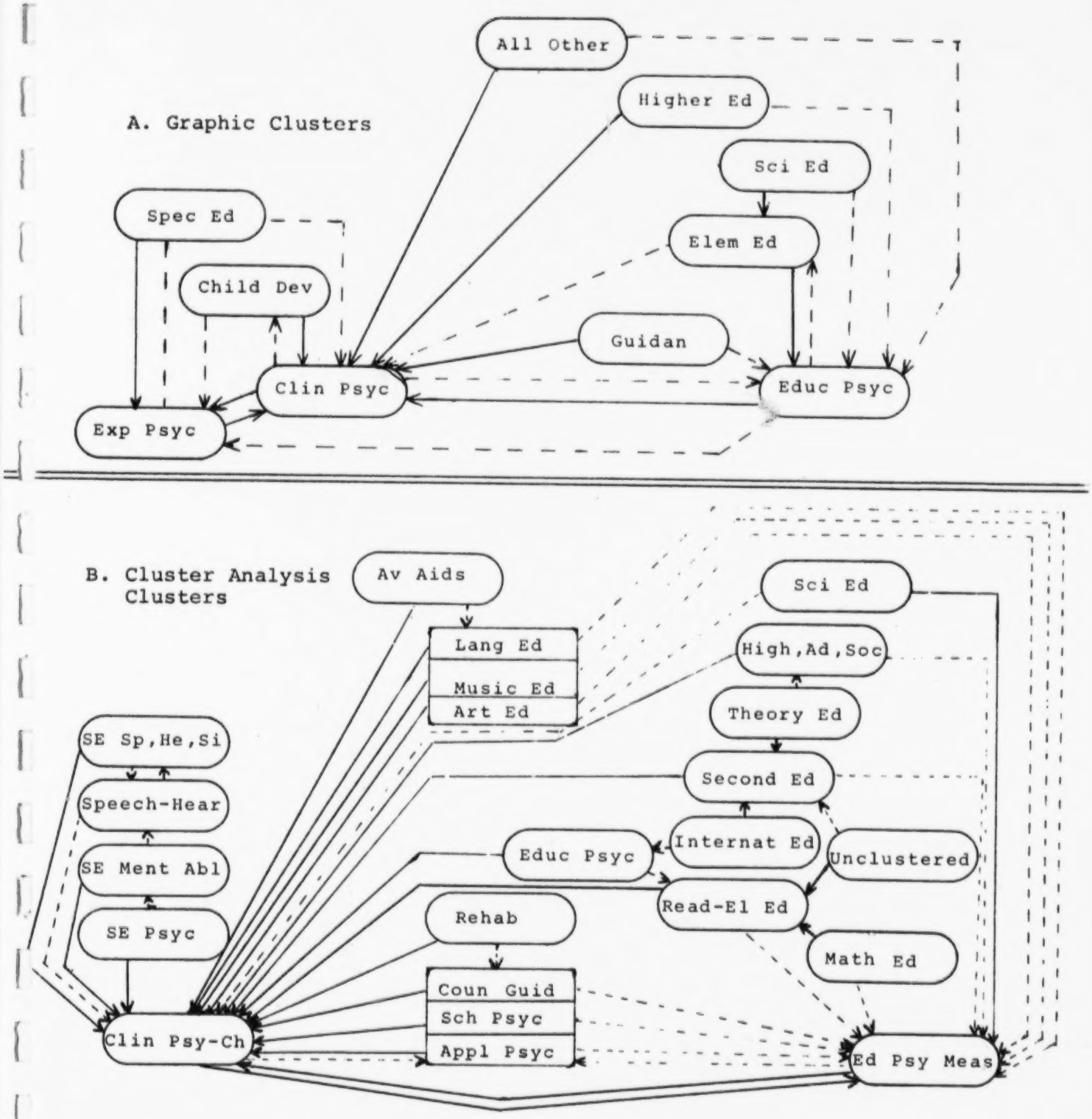


FIGURE 13 - TWO-STEP CLUSTER MAPS

VI. HIERARCHIES

A further means of showing the orderliness and dependency relations in the education literature is through construction of hierarchies, in which heavily cited journals or clusters lie toward the base. Three major hierarchies were constructed. Figure 14 shows a hierarchy of graphic clusters, Figure 15 a hierarchy of clusters derived from cluster analysis, and Figure 16 shows a detailed hierarchy of individual journals.

Figures 14 and 15 clearly show that psychology forms the base of educational research. In these hierarchies a cluster A is placed above a cluster B, if cluster A gives cluster B a higher percentage of its total citations than B gives A. The hierarchies are fully transitive: if C is above D, and D is above E, then C is above E and almost always all of the relationships C/D, D/E, and C/E are satisfied. Therefore we see, in Figure 15, that the cluster labeled "Psychology and Child Development" is referred to a larger percentage of the time by all of the other 22 clusters, than it refers to any of them. Similarly the clusters labeled "Experimental Psychology" and "Clinical Psychology" in Figure 14 are at the base of its hierarchy.

If at least one of a pair of clusters refers to the other at least 1 percent of the time the relationship is considered significant. Conflicts arise when the citations a cluster G gives one cluster H should place it above H, yet cluster I, which is below H, gives G enough citations to warrant placing G below I. Since cluster G must be placed somewhere a conflict results when it is placed. The conflict is a significant conflict only if conflicting clusters differ in their citing of each other by more than 1 percent.

The individual journal hierarchy also shows psychology's preminence in education. At the base of the hierarchy are psychology journals; all of the first 11 journals on the trunk of the hierarchy are psychology journals belonging to the experimental and clinical psychology clusters in the two-step maps.

Branches on the hierarchy also reflect the structure developed in the two-step maps and cluster analysis clusters. Branches are formed by simply pulling out of the main stem those journals which bear close relationships to each other. But any journal on a branch can be placed back on the main stem without altering the order of the hierarchy. Let us take the placing of the journal Phi Delta Kappan as an illustrative example: Phi Delta Kappan appears on a branch emanating from Review of Education Research. The next highest journal on the trunk, School Review, cites Phi Delta Kappan more

Rank by Size	Cluster
10	Other
9	Science and Science Ed
7	Higher Ed and General Ed
8	Elem Ed and Ed Res
6	Guidance
3	Ed Psyc and Research
5	Child Development
4	Special Education
2	Psychology
1	Exp Psych

45 possible relationships
42 significant relationships ($\geq$1% at least one way)
3 insignificant relationships
no conflicts of any kind

FIGURE 14 - HIERARCHY OF GRAPHIC CLUSTERS

Rank by Size	Cluster
20	Rehabilitation
19	Language Education
14	School Psych
22	Art Education
21	Music Education
22	International Education
9	Special Education - Speech, Hearing, Sight
16	Audio-Visual Aids
17	Math Education
11	Science Education
18	Unclustered
13	Educational Psychology
15	Theory of Education
10	Secondary Education
4	Counsel and Guidance
7	Higher Education - Educational, Administration, Sociology
6	Special Education - Psychological
5	Reading and Elementary Education
2	Special Education - Mental Abilities
12	Speech-Hearing
8	Applied Psychology
3	Educational Psychology and Measurement
1	Clinical Psychology and Child Development

253 possible relationships
214 actual relationships
124 significant relationships ($\geq$1% at least one way)
90 insignificant relationships
1 significant conflict at $\geq$1%
19 insignificant conflicts

FIGURE 15 - HIERARCHY OF CLUSTER ANALYSIS CLUSTERS

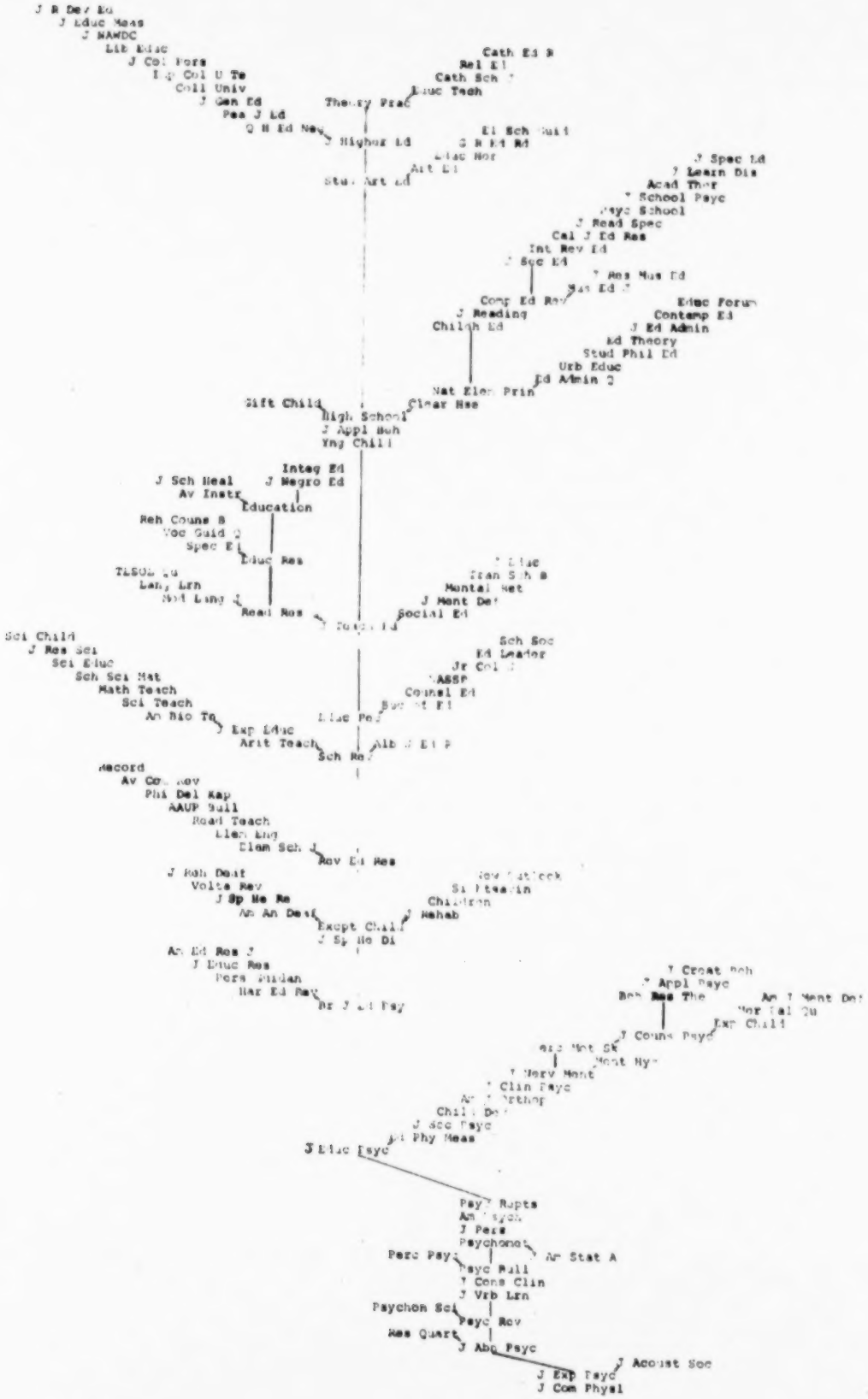


FIGURE 16 - HIERARCHY OF JOURNALS IN EDUCATION

than Phi Delta Kappan cites it, so Phi Delta Kappan belongs below it on the hierarchy. Yet Phi Delta Kappan is one of a group of journals which all give School Review a smaller percentage of their citations than School Review gives them (or have no significant relationship with School Reviews). Therefore that group of journals all belong below School Review on the hierarchy. In addition, that group of journals - Record, Audiovisual Communications Review, Phi Delta Kappan, American Association of University Professors Bulletin, Reading Teacher, Elementary English, and Elementary School Journal - heavily cite each other and Review of Education Research and belong above Review of Educational Research on the hierarchy. Consequently, to show that they are closely associated, they have been placed on a branch. As a general rule any journal on a branch may be considered to occupy the same position with respect to those journals above it on the hierarchical tree as the journal from which its branch emanates, and journals on a branch can be considered to be above those further in on the same branch.

Note that near the bottom of the individual journal hierarchy the straight line of the main trunk is broken. A branch comes off at Psychological Reports, and the trunk continues upward from the first journal of that branch, the Journal of Educational Psychology. This is intended to illustrate the structure of the field of education as it has been determined through measures we employ in this report. The Journal of Educational Psychology is the most oft cited journal in our sample; 110 journals of the 140 in our sample give it an average of 2.5 percent of their citations. Further, 96 of the 118 journals remaining when psychology journals are excluded give it an average 2.6 percent of their citations, and it is located at the center of the educational psychology and research graphic cluster. If we view a hierarchy as a tree, the Journal of Educational Psychology may be considered the base of education research, the eleven psychology journals on the trunk below it, its roots.

The line is not straight at the bottom of the hierarchy for a similar reason. The Journal of Abnormal and Social Psychology is the second most frequently cited journal in our sample even when citations from 22 psychology journals are excluded. It is cited by 89 journals at an average rate of 2.3 percent when psychology citations are excluded, and by 105 journals at an average of 3.6 percent when they are included. In addition it is at the center of the clinical psychology graphic cluster. Thus it is pictured in Figure 14 at the base of the straight line "root" of the hierarchy. Yet it is dependent on a more basic journal, the Journal of Experimental Psychology, which is also the center of the experimental psychology graphic cluster. Only 80 journals give an average of 2.6 percent of their citations to the Journal of Experimental Psychology when citations from the whole journal set are utilized,

and 64 journals give only 1.9 percent of their citations to it when citations from psychology journals are excluded. As we see it is cited by far fewer journals than either the Journal of Abnormal and Social Psychology or the Journal of Educational Psychology. So we may conclude that the Journal of Experimental Psychology is more important to psychology and psychology journals than it is to education journals. Though the Journal of Experimental Psychology belongs below the Journal of Abnormal and Social Psychology on the hierarchy, it is less on the main line of educational research, more of a taproot instead, and for that reason it has been placed below, but to the side of the Journal of Abnormal and Social Psychology.

There is a journal lower on the hierarchy that the Journal of Experimental Psychology, but it is important to only a few of the journals in our set. The Journal of Comparative and Physiological Psychology has significant relationships with only thirteen journals, all of them psychology journals and is in conflict with one of them. It receives 1 percent or more of the total number of journal citations from only twelve journals in our set, gives at least 1 percent of its journal citations to only three of those twelve, and gives 2 percent of its citations to one other journal in our set, Psychological Bulletin, making a total of thirteen separate journals. Unfortunately the 2 percent citations it gives to that journal put it in conflict with three of the other journals it receives citations from.* Since the Journal of Comparative and Physiological Psychology receives a higher percentage of citations of those three journals citations than it gives to them, it belongs below them on the hierarchy. Yet because it gives Psychological Bulletin 2 percent of its citations and receives less than 0.5 percent of Psychological Bulletin's citations, the Journal of Comparative and Physiological Psychology belongs above Psychological Bulletin. To put it above would create conflicts with the three journals below Psychological Bulletin that belong above the Journal of Comparative and Physiological Psychology. So to minimize the conflicts that the placement of the Journal of Comparative and Physiological Psychology in the hierarchy was bound to create, it was put at the base of the hierarchy, putting it in conflict with only one journal, and that at less than 2 percent.

We may say then that because it has significant relationships with only a few psychology journals, the Journal of Comparative and Physiological Psychology is not really part of education. So the Journal of Experimental Psychology remains the most broadly fundamental journal on this hierarchy of education and related journals.

*The three journals are Psychonomic Science, Psychological Review and Journal of Experimental Psychology.

Of approximately 1450 significant relationships between journals, 21, or 1.5 percent, resulted in conflicts when this hierarchy was constructed. That is another, perhaps the best, indication that this hierarchy, with psychology journals at its base, is a real and well ordered one.

VII. PROPOSED CORE JOURNALS

A series of programs were developed to identify core journals, using the standard cross citing matrix. We established three criteria for importance. Measures were assigned on the basis of (1) the number times a journal received 1 percent or more of another journal's citations, (2) the number of times it was cited at all, and (3) the mean of the percent level of citations to it from those journals citing it at all. Journals were classified into various categories on the basis of those measures of journal importance. Categories were delineated for three different sets of journal citations.

The first set makes use of all the citations from and to all the journals in our sample. The second set uses only citations from education journals, to all the journals in the sample. It does not include any citations from psychology journals. The third set excludes all references to and from psychology and so covers only citations from education journals to education journals. Table 8 shows the resulting classification of journals into categories. We took as psychology journals all of those found in the clinical psychology and experimental psychology graphic clusters. Table 9 has these journals.

Categories 1 through 5 represent distance from the core of a field with category 1 at the core and category 5 on the periphery. Category 1 contains the core journals. They rank highest on at least two of the three measures of journal importance used, the number of times the journal was cited at a 1 percent level or greater by another journal, the number of times it was cited at all by another journal, and the mean percentage of citations from all those journals citing it. Category 2 journals are those near the core; they are heavily used, but not quite as much as those at the core. The broad middle of the field is found in category 3. Journals in category 3 are cited often, but not often enough; they cite journals in categories 1 and 2, and are in turn cited by journals in categories 4 and 5 and by each other. In category 4 are those journals less frequently cited by other journals in our sample but still utilized often enough to avoid being considered peripheral. The journals of peripheral importance to the field are found in category 5. Peripheral journals rank low in all of the measures of journal importance mentioned above. Many of them are members of subfields but they are not cited enough to demonstrate that fact using these measures.

There are two additional categories as well, category 6 which identified subfield cores, and category 7, members of a subfield. If a journal was cited most often by a small number of journals in our sample, while having few relationships with the other journals in the sample, it was placed in category 7. Category 6 is reserved for those subfield members that are very highly cited by those few journals that cite it.

TABLE 8

JOURNAL IMPORTANCE CATEGORIZATION

Citings From All to All	Citings From Ed to All	Citings From Ed to Ed
Set I	Set II	Set III
	Category 1 - Core Journals	
Am Psych	Am Psych	Child Dev
Child Dev	Child Dev	Har Ed Rev
J Abn Psyc	J Abn Psyc	J Educ Psyc
J Educ Psyc	J Educ Psyc	J Educ Res
J Exp Psyc	Pers Guidan	Pers Guidan
Psyc Bull	Psyc Bull	Rev Ed Res
Psyc Bull	Psyc Bull	
	Category 2 - Near Core Journals	
Am J M Def	Am J M Def	Am J M Def
Har Ed Rev	Har Ed Rev	J Coun Psyc
J Cons Clin	J Coun Psyc	J Exp Educ
J Educ Res	J Educ Res	Sch Rev
Pers Guidan	Phi Del Kap	Phi Del Kap
Psyc Rev		
	Category 3 - Mid-Range Journals	
Am J Orthop	Am J Orthop	Am Ed Res J
Br J Ed Psy	Br J Ed Psy	Am J Orthop
Education	Education	Br J Ed Psy
Ed Phy Meas	Ed Phy Meas	Education
Elem Sch J	Elem Sch J	Educ Res
Excep Child	Excep Child	Elem Sch J
J Appl Psyc	J Appl Psyc	Excep Child
J Clin Psyc	J Clin Psyc	J Exp Child
J Com Physl	J Cons Clin	J Sp He Di
J Coun Psyc	J Exp Educ	J Teach Ed
J Exp Educ	J Exp Psyc	Perc Mot Sk
J Pers	J Teach Ed	Read Teach
J Teach Ed	Perc Mot Sk	Record
J Vrb Lrn	Psyc Rev	Elem Eng
Perc Mot Sk	Read Teach	Mer-Par Qu
Psyc Repts	Rev Ed Res	A V Com Rev
Psychomet	Sch Rev	Sch Soc
Rev Ed Res	Elem Eng	NASSP
Sch Rev	NASSP	Clear Hse
Elem Eng		Educ Rec
NASSP		J Higher Ed
Phi Del Kap		A V Instr
		Ed Leader
		Arit Teach
		Sch Sci Mat
		Social Ed

TABLE 8 (Continued)

JOURNAL IMPORTANCE CATEGORIZATION

Citings From All to All	Citings From Ed to All	Citings From Ed to Ed
Set I	Set II	Set III
	Category 4 - Near-Periphery Journals	
Am Ed Res J	Am Ed Res J	Educ Forum
J Nerv Ment	Educ Forum	Ment Hyg
J Soc Psyc	J Pers	Psyc School
Ment Hyg	J Soc Psyc	Soc of Ed
Record	Psyc Repts	Cal J Ed Res
Soc of Ed	Psychomet	Nat El Prin
Mer-Par Qu	Record	Childh Ed
Sch Soc	Soc of Ed	
Cal J Ed Res	Mer-Par Qu	
Ed Leader	Sch Soc	
	Clear Hse	
	Cal J Ed Res	
	Nat El Prin	
	Ed Leader	
	Category 5 - Peripheral Journals	
Children	Children	Am Psych
Educ Forum	Gift Child Q	Beh Res The
Gift Child Q	High School	Ed Phy Meas
High School	J Am Stat A	Gift Child Q
J Am Stat A	J Appl Beh	J Abn Psyc
J Appl Beh	J Educ	J Am Stat A
J Educ	J Educ Meas	J Appl Beh
J Educ Meas	J Learn Dis	J Appl Psyc
J Learn Dis	J Ment Def	J Clin Psyc
J Ment Def	J Reading	J Com Physl
J Reading	J Sch Heal	J Cons Clin
J Reh Deaf	J Sec Ed	J Educ
J Sch Heal	J Spec Ed	J Educ Meas
J Sec Ed	J Sch Psyc	J Exp Psyc
J Sch Psyc	New Outlook	J Learn Dis
New Outlook	Perc Psyc	J Nerv Ment
Perc Psyc	Psyc School	J Pers
Psyc School	Train Sch B	J Sch Heal
Read Res Q	Yng Child	J Soc Psyc
Train Sch B	J R Dev Ed	J Vrb Lrn
Yng Child	Alb J Ed R	New Outlook
J R Dev Ed	G R Ed R D	Psyc Bull
Alb J Ed R	El Sch Guid	Psyc Repts
G R Ed R D	J Ed Admin	Psyc Rev
El Sch Guid	Educ Hor	Psychomet
J Ed Admin	TESOL Qu	Psychonom S
Educ Hor	Int Rev Ed	Train Sch B
TESOL Qu	Pea J Ed	Yng Child

TABLE 8 (Continued)

JOURNAL IMPORTANCE CATEGORIZATION

Citings From All to All	Citings From Ed to All	Citings From Ed to Ed
Set I	Set II	Set III
Category 5 - Peripheral Journals (Continued)		
Int Rev Ed	Lib Educ	J R Dev Ed
Pea J Ed	Integ Educ	Alb J Ed R
Sci Child	J Gen Ed	G R Ed R D
Lib Educ	J NAWDC	El Sch Guid
Integ Educ	Urb Educ	J Ed Admin
J Gen Ed	Contemp Ed	Educ Hor
J NAWDC	J Read Spec	TESOL Qu
Urb Educ	Childh Ed	Pea J Ed
Contemp Ed	St Phil Ed	Lib Educ
J Read Spec	H Ed Negro	Integ Educ
Childh Ed	Theory Prac	J Gen Ed
St Phil Ed	J Creat Beh	Urb Educ
H Ed Negro	Voc Guid Q	Contemp Ed
Theory Prac	Imp Col U Te	J Read Spec
J Creat Beh	Educ Tech	St Phil Ed
Voc Guid Q	Cath Sch J	H Ed Negro
Imp Col U Te	Rel Educ	Theory Prac
Educ Tech	Cath Ed R	J Creat Beh
Cath Sch J	Ed Theory	Voc Guid Q
Rel Educ	J Negro Ed	Imp Col U T
Cath Ed R		Educ Tech
Ed Theory		Cath Sch J
J Negro Ed		Rel Educ
		Cath Ed R
		J Negro Ed
Category 6 - Subfield Core Journals		
	Am Ann Deal	Am Ann Deaf
	J Acoust So	Volta Rev
Category 7 - Subfield Journals		
Acad Ther	Acad Ther	Acad Ther
Beh Res The	Beh Res The	Children
Comp Ed Rev	Comp Ed Rev	Comp Ed Rev
Counsl Ed	Counsl Ed	Counsl Ed
Educ Res	Educ Res	High School
J Acoust So	J Com Physl	J Acoust So
J Exp Child	J Exp Child	J Ment Def
J Rehab	J Nerv Ment	J Reading
J Res Sci	J Rehab	J Rehab
J Spec Ed	J Reh Deaf	J Reh Deaf
J Sp He Di	J Res Sci	J Res Sci
J Sp He Re	J Sp He Di	J Sec Ed

TABLE 8 (Continued)

JOURNAL IMPORTANCE CATEGORIZATION

Citings From All to All	Citings From Ed to All	Citings From Ed to Ed
Set I	Set II	Set III
Category 7 - Subfield Journals (Continued)		
Ment Ret	J Sp He Re	J Spec Ed
Psychonom S	J Vrb Lrn	J Sp He Re
Read Teach	Ment Hyg	J Sch Psyc
Reh Couns B	Ment Ret	Ment Ret
Res Quart	Psychonom S	Perc Psyc
Sightsaving	Read Res Q	Read Res Q
Spec Ed	Reh Couns B	Reh Couns B
Volta Rev	Res Quart	Res Quart
Sci Educ	Sightsaving	Sightsaving
A V Com Rev	Spec Ed	Spec Ed
J Res Mus Ed	Volta Rev	Sci Educ
Art Educ	Sci Educ	J Res Mus Ed
Clear Hse	A V Com Rev	Art Educ
Educ Rec	J Res Mus Ed	Stud Art Ed
Stud Art Ed	Art Educ	Int Rev Ed
J Higher Ed	Educ Rec	Sci Child
Jr Col J	Stud Art Ed	Jr Col J
A V Instr	J Higher Ed	J NAWDC
AAUP Bull	Sci Child	AAUP Bull
Lang Lrn	Jr Col J	Lang Lrn
Coll Univ	A V Instr	Coll Univ
Mus Ed J	AAUP Bull	Mus Ed J
Nat El Prin	Lang Lrn	Ed Admin Q
Ed Admin Q	Coll Univ	Mod Lang J
Mod Lang J	Mus Ed J	Math Teach
Math Teach	Ed Admin Q	Sci Teach
Sci Teach	Mod Lang J	Am Bio Te
Arit Teach	Math Teach	J Col Pers
Sch Sci Mat	Sci Teach	Ed Theory
Am Bio Te	Arit Teach	
J Col Pers	Sch Sci Mat	
Social Ed	Am Bio Te	
	J Col Pers	
	Social Ed	

TABLE 9

PSYCHOLOGY JOURNALS

J Abn Psyc	Journal of Abnormal and Social Psychology
J Soc Psyc	Journal of Social Psychology
J Pers	Journal of Personality and Social Psychology
J Cons Clin	Journal of Consulting Clinical Psychology
J Nerv Ment	Journal of Nervous and Mental Disorders
J Clin Psyc	Journal of Clinical Psychology
Ed Phy Meas	Educational and Psychological Measurement
Psychomet	Psychometrica
J Ed Meas	Journal of Educational Measurement
J Am Stat A	Journal of American Statistical Association
J Appl Psyc	Journal of Applied Psychology
Psyc Bull	Psychology Bulletin
Psyc Repts	Psychological Reports
Am Psych	American Psychologist
J Creat Beh	Journal of Creative Behavior
J Com Physl	Journal of Comparative and Physiological Psychology
Psychonom S	Psychonomic Science
J Exp Psyc	Journal of Experimental Psychology
Psyc Rev	Psychology Reviews
J Vrb Lrn	Journal of Verbal Learning and Verbal Behavior
Beh Res The	Behavioral Research and Therapy
J Appl Beh	Journal of Applied Behavioral Psychology

It is most important to note in this comparison the extraordinary stability of the categories whether citations from psychology journals are included, as in Set 1, or excluded as in Set 2. In fact, because of the very high self-referencing of the psychology journals; experimental psychology cites itself and clinical psychology 52.6 percent of the time and the rest of the set only 3.1 percent, the figures for clinical psychology are 52.7 percent and 6.7 percent respectively; our best estimate of the core and related journals in education is Set 2. Set 2, which uses citations from the educational journals to the entire set, isolates six core journals.

In order of importance they are:

1. Journal of Educational Psychology - This journal is cited by more journals than any other in each set of categories, is the center of a graphic cluster, and is chosen as a core journal in all three sets of categories.

2. Child Development is a core journal in each set of categories, is at the center of a graphic cluster and ranks fifth in the number of journals in our sample citing it.

3. Journal of Abnormal and Social Psychology - This is the most heavily used psychology journal in our sample. It ranks second in the number of journals which cite it, and when citations from psychology journals are included, as they are in Set 1, it receives more individual citations than any journal of any kind in our sample. In addition, it is twice identified as a core journal and is at the center of a graphic cluster.

4. Personnel and Guidance Journal - Though referred to by fewer journals than the other core journals, Personnel and Guidance Journal has the highest mean percent citations of the core journals; those journals citing it give in an average of 3 percent of their journal citations. It appears as a core journal twice, and in category 2 the third time, and is at the center of a graphic cluster.

5. Psychological Bulletin - This journal is referred to by the fourth largest number of journals in our sample. It links experimental and clinical psychology and was twice chosen as a core journal.

6. American Psychologist - Ranks third in our sample in the number of journals citing it. It was chosen twice as a core journal.

Five of the six journals above were also chosen as core journals in Set 1, when citations from all the journals in our sample, to all the journals in our sample were used to determine the core. In Set 1 the Journal of Experimental Psychology appeared where the Personnel and Guidance Journal appears in Set 2. That is only logical. When citations from psychology are included in determining the core of a set of journals the center of the experimental psychology graphic cluster should gain importance over an education and guidance oriented journal such as the Personnel and Guidance Journal.

The last mentioned journal Personnel and Guidance Journal does appear in the core of Set 3 confirming its importance to education, inasmuch as Set 3 is built upon references to education journals, from education journals alone. Three new journals appear in the core of this set. The Harvard Educational Review and Journal of Educational Research were both category 2, near-core, journals in the other sets. The third journal, Review of Education Research, rose from its position in category 3 in the two other sets of categories of journals. In addition both of the first two journals are at the center of a graphic cluster while the third is not, all of which suggests that reviews of educational research, and by implication educational research itself, take a back seat to psychology and psychological research and gain importance only when psychology is ignored.

The importance of Table 8 lies not only in category 1, the core journals, but in all the categories. We have shown the core journals in the field, and gradations of journals out from the core to the periphery in a systematic way. In addition, Table 8 shows which of our 140 journal sample are subfield cores, category 6, as well which journals are primarily members of subfields, category 7. Figure 17 illustrates that graphically. The area between the circles represents the number of journals appearing in each category. We see that the core of education is represented by a very few journals. There is a broad band of frequently used journals but a far wider one of essentially peripheral journals. In addition a large number of journals belong to subfields but very few can unequivacably be placed at the core of a tightly knit subfield.

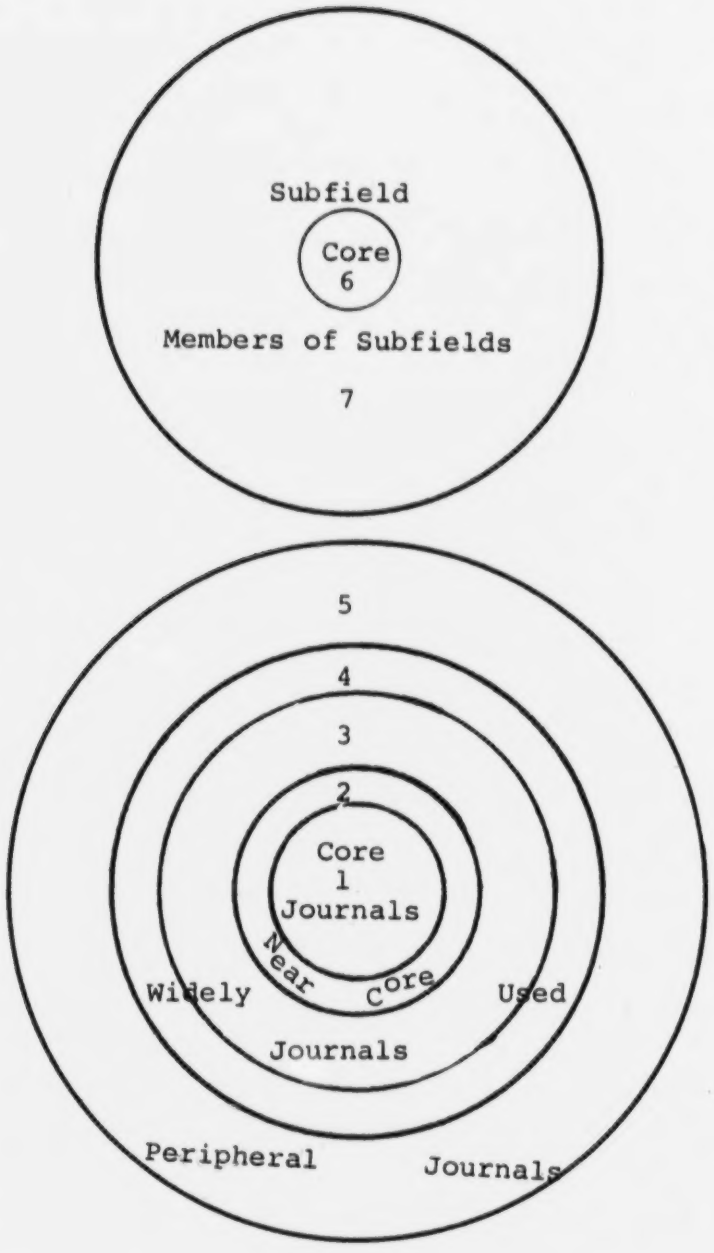


FIGURE 17 - THE RELATIVE SIZE OF CATEGORIES OF EDUCATION JOURNALS

VIII. RESULTS AND CONCLUSIONS

The universe of scholarly journals in education is small, though highly populated at the edges. The difficulties involved in data gathering alone substantiate this conclusion. In order to adequately cover the field we were forced to employ a much lower standard of scholarliness (100 references per year) to the journals than is used for the scientific literature. And even then additional safeguards had to be used to insure that no journal was overlooked, since the low level of reference precludes complete reliance on citations. Our final journal sample thus included every journal that was highly cited by other education journals and could be considered to belong to the field of education as well as many that are not centrally important. But the significant journals stand out above the others. No one could miss Child Development, the Journal of Educational Psychology, School Review, or Elementary English. But the California Journal of Educational Research and Reading Teacher are obviously less important to the field. And High School and the Junior College Journal, though used often by some, are not known to everyone in education.

The field of education is nonetheless highly structured. Two-step maps, cluster analysis, hierarchies of clusters and of journals, and identification of core journals, all point to the same structure of well defined subfields resting on a base of experimental and clinical psychology. What we have called graphic clusters may also be called subfields. We refer back to Figure 12 to show what each method of analysis has shown; psychology is the main source of commonly accepted knowledge in education. Subfields easily define themselves, are obviously identifiable, and are clearly delineated from other subfields.

Each of the hierarchies, Figures 14, 15 and 16 show psychology journals, or clusters of psychology journals, at the roots of education. The Special Education report concluded that special education depended primarily on psychology for its basic information and referred little to general education. This report shows that most of education relies primarily on psychology and defines, in addition, the structure of the various subfields of education.

That these subfields have a definite internal structure and relate to each other in a systematic way was made clear in the two-step maps section of this report. Figure 12 again illustrates the primacy of psychology as the main source of information for many journals. Clinical psychology receives the most arrows, but gives arrows in turn to experimental psychology; both subfields give a single arrow to the journal Science, suggesting that psychology is, in turn, dependent on biochemistry and the hard sciences.

Educational psychology and research is also a source of information, particularly for elementary education and research. But educational psychology and, through it and guidance, elementary education, also rely directly on clinical and experimental psychology. Each of those three subfields, because of their heavy interaction with each other and the rest of the subfields, are obviously in the mainstream of education research. The child development subfield appears to be a conduit to psychology for other subfields. The same can be said for the guidance subfield, but there the mechanism is different. Guidance itself contains a number of psychology journals so its link with psychology is more direct.

It is interesting to note that two subfields, special education, and higher and general education, have only one arrow leading into them. The two-step map of the subfields, Figures 2 and 9, hint at the reasons for this. The former displays a great deal of internal structure, while the latter is loose knit with 3 or 4 epicenters. This suggests that special education is a self sufficient subfield depending primarily on itself and psychology for its source information and thus is not a primary source of information for other areas of education. Indeed this is a major conclusion of the Special Education report.

Higher and general education, on the other hand, with its highly dispersed, more generalized internal structure, depends on sources of data outside of the field of education. Consequently its publications are not of prime importance to others in the field of education because they lack information of a purely educational nature. Science and science education, unlike the others, is generally self sufficient because it draws primarily on scientific research for its information.

So it can be seen that most of education depends directly, or through other subfields of education on psychology, primarily clinical psychology, but directly and indirectly through clinical psychology, on experimental psychology.

Experimental psychology may be called the tap root of educational research. This is borne out by other measures in this report. Experimental psychology is at the base of the hierarchy of two-step map clusters (Figure 14). The journals in the cluster at the base of the cluster analysis hierarchy (Figure 15) are largely experimental psychology journals, as are the journals at the base of the individual journal hierarchy (Figure 16). In addition it has the second highest ratio of citations to it by citations from it; i.e., it receives nearly twice as many citations from other subfields as it gives to other subfields in this sample..

Figure 18 illustrates a number of important points on the nature of the field of education. It shows, as histograms,

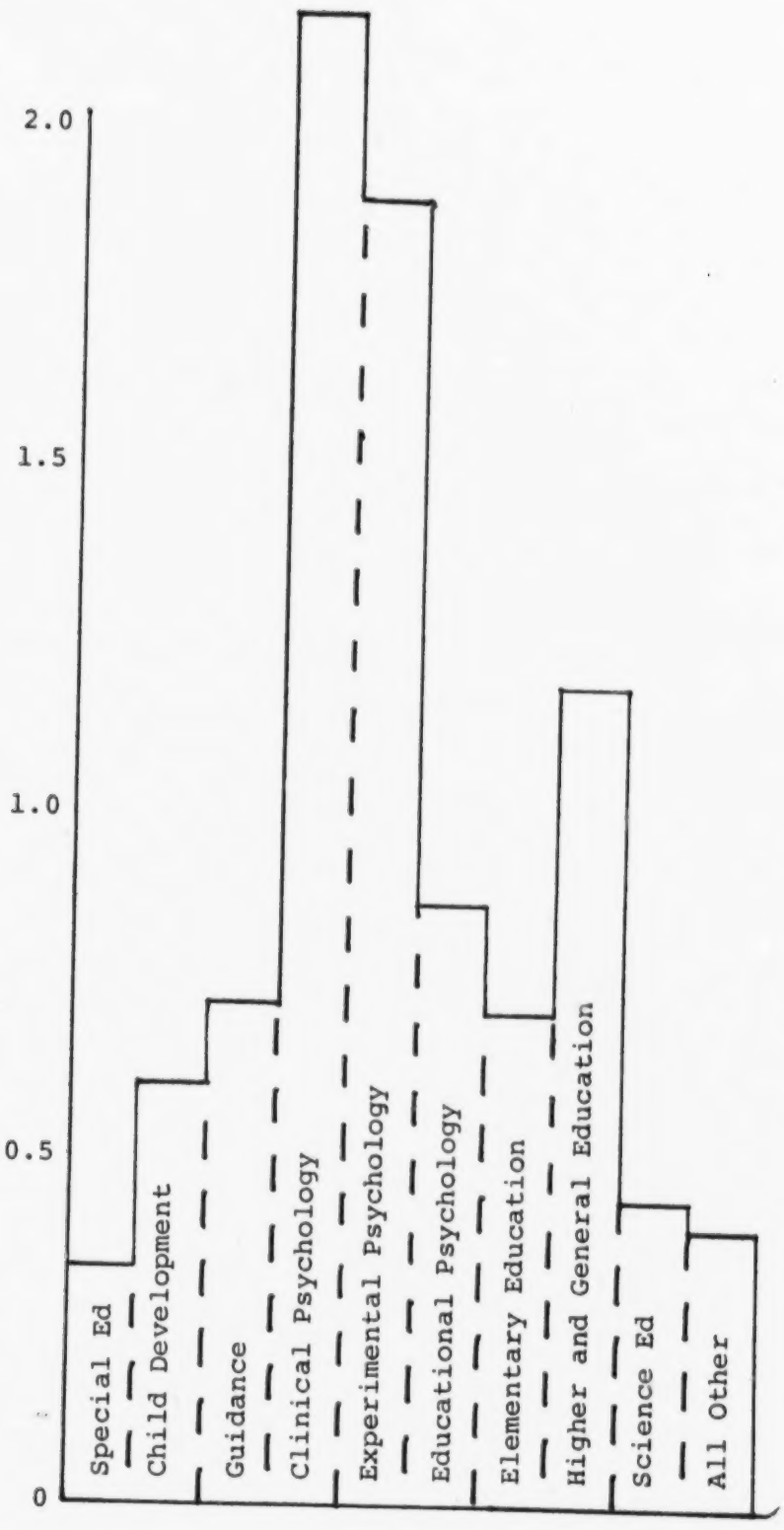


FIGURE 18 - RATIO OF CITATIONS TO/CITATIONS FROM BY SUBFIELD

the ratio between the citations a subfield receives from other subfields, and the citations from that subfield to other subfields. This to/from citation ratio excludes the citations each subfield gives to itself so it measures the cross-subfield citing only. Figure 18 demonstrates the use the subfields make of each other. The subfield with the highest to/from ratio is clinical psychology. This is perfectly reasonable in the light of our earlier statements about the importance of psychology to education. It is only natural that clinical psychology, which deals directly with people, should receive the most citations to its work. That this high ratio of citations to/citations from results from a high absolute number of citations is shown in Figure 19.

In Figure 19 the solid line shows what percentage of the total number of cross-subfield citations each subfield receives. The broken line indicates the percentage of the cross-subfield citations each subfield gives. Cross-subfield citation includes only citations to journals in our set and excludes the citations each subfield gives to journals within its own subfield. Here clinical psychology is seen to have the highest absolute number of citations of any subfield in education.

Only one cluster other than clinical psychology and experimental psychology, higher and general education, has a ratio of citations to/citations from greater than 1. That higher and general education is cited more often by other subfields of education than it cites them, is evidence that this subfield serves as a link to the social sciences and humanities. Information from those disciplines enters the field of education through the journals in the higher and general education subfield. It is imperative to note at this time, however, that, as Figure 19 illustrates, only 4 percent of the total cross subfield citations go to this subfield. This is insignificant compared to the 31.8 percent and 22.6 percent of cross subfield citations that are received by clinical and experimental psychology respectively. Though one of the journals in general and higher education, the Harvard Educational Review, is a centrally important journal in education, the subfield as a whole is not of prime importance to educators.

We also see in Figure 18 three subfields that are clearly on the periphery of the field of education; each of them cites other subfields far more often than it is cited by them. Special education, as has been noted, is almost a field into itself; so is science and science education. The all other graphic cluster contains all those journals whose specialized nature was such that they had no direct link, through first or second arrows, with the other subfields. These are, almost by definition, on the periphery as a look at them in Figure 11 will show.

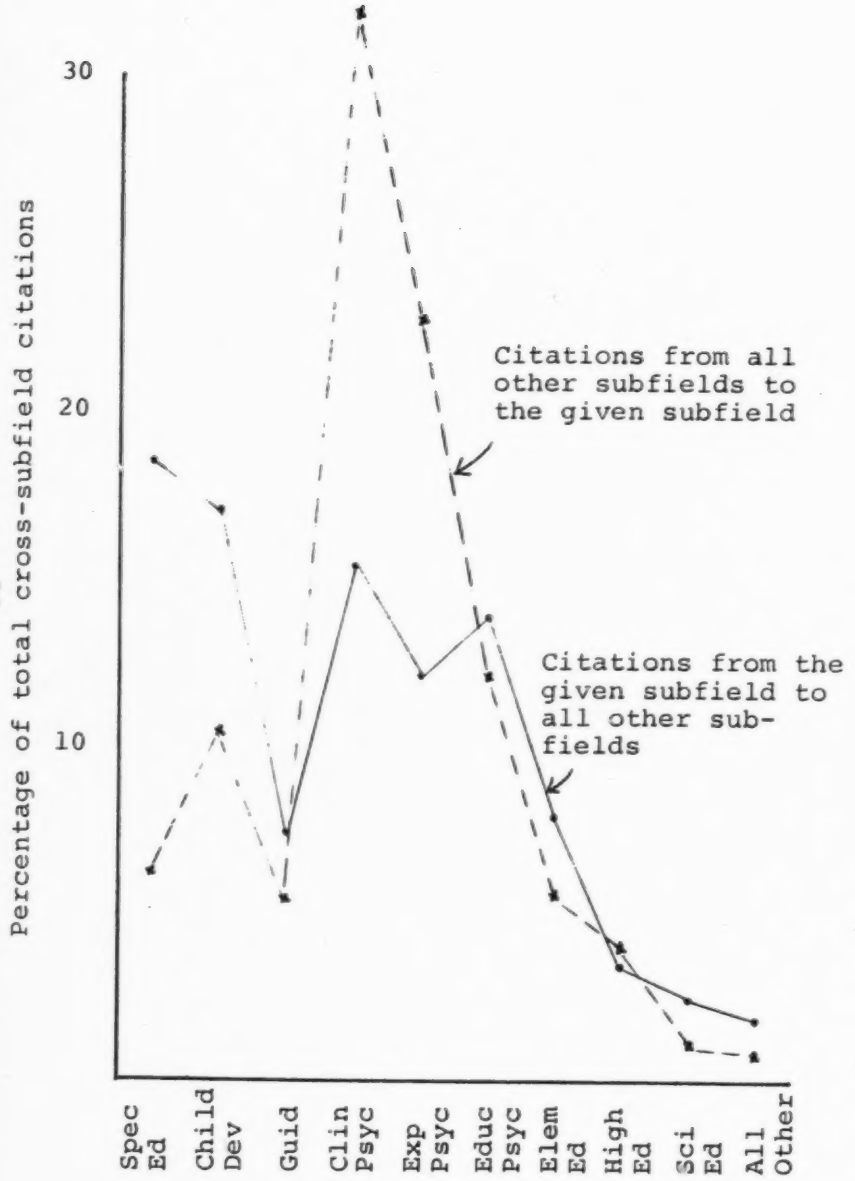


FIGURE 19 - CROSS SUBFIELD CITATION PATTERNS

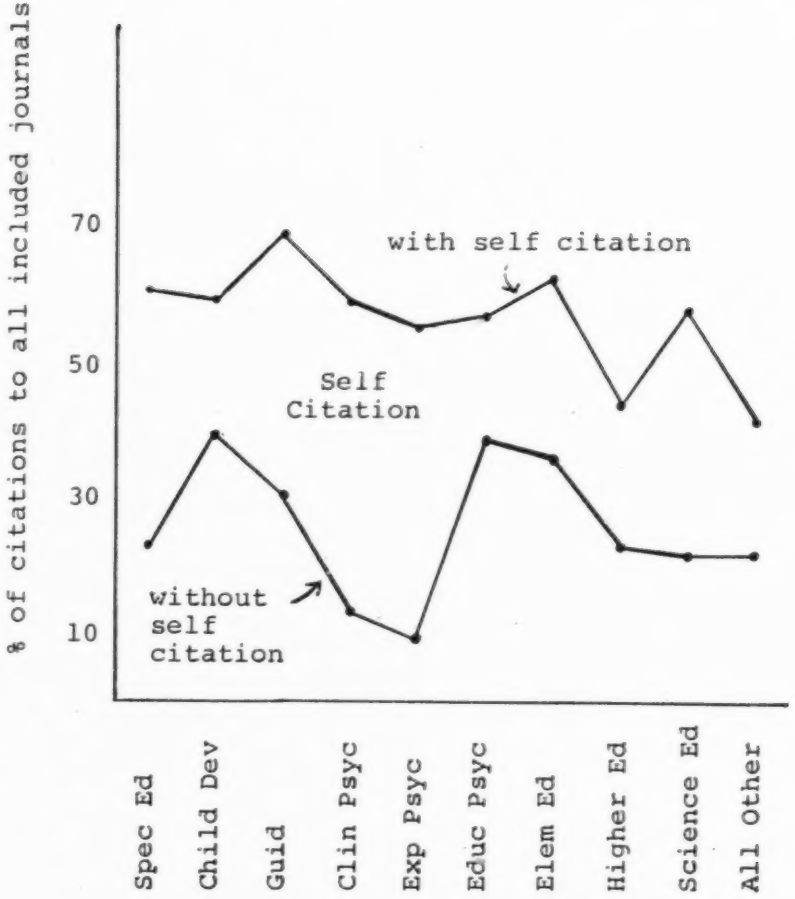


FIGURE 20 - CITATIONS FROM SUBFIELDS TO INCLUDED JOURNALS, WITH AND WITHOUT SELF CITATION

We turn to Figure 20 to illustrate the centrality of certain subfields in education. The top line on the graph represents the percentage of its total journal citations each cluster gives to our journal set. The bottom line shows those percentages without self citation; i.e., with citations to journals within the subfield excluded. Thus the shaded area between the lines shows the effect of subfield self-citation on cross cluster citing.

We see that eight of the clusters give 55 percent or more of their references to our journal set.* But when the effects of in-cluster citing are removed three distinct classes of clusters appear. Four subfields (call them Class I) child development, guidance, educational psychology and research, and elementary education and research, give between 30 percent and 40 percent of their total journal citations to other subfields in education. Four others, Class II, special education, science and science education, higher and general education and all other, fall within the narrow range of 22 to 23 percent. And two, clinical psychology, and experimental psychology, give only 13.7 percent and 9.8 percent, respectively, of their citations to other subfields in education. (These last are Class III).

Class II subfields are all areas that have been shown above to be either self sufficient or closely linked to other disciplines. They are in education, but not of it. The two Class III subfields have already been identified as education's major source of the field's accepted common body of information. Thus Class I subfields represent the main body of education research. Child development (39.9%) and educational psychology and research (38.4%) make the heaviest use of educational journals. They are followed closely by elementary education and research (35.7%); and finally, at 31.2 percent usage of other education journals, guidance. These fields represent education's central core, where work most dependent on other subfields of education is done.

*The other two, higher and general education and all other, are, as has been noted previously, on the periphery of the field of education.

IX. REFERENCES

1. Guilford, P. J., "The Nature of Human Intelligence," McGraw-Hill, Inc., (1967).

2. Narin, Francis, "Analysis of Research Journals, and Related Research Structure, in Special Education," Contract No. OEC-5-70-0047(509) for the Office of Education (February 1971).

3. Cole, F. J. and Eales, Nellie B., "The History of Comparative Anatomy," Science Progress XI, 578-596 (1917).

4. Hulme, E. W., "Statistical Bibliography in Relation to the Growth of Modern Civilization," London, Grafton (1923).

5. Gross, P.L.K. and Gross, E. M., "College Libraries and Chemical Education," Science 66, 1713, 385-389 (1927).

6. Stevens, Rolland E., "Characteristics of Subject Literatures," Assoc. of College and Reference Libraries Monograph No. 6, 10-21.

7. Bradford, S. C., "Sources of Information on Specific Subjects," Engineering (London) 137, 85-86 (1934).

8. de Solla Price, Derek J., Little Science Big Science, Columbia University Press, New York (1963).
de Solla Price, Derek J., Science Since Babylon, Yale University Press, New Haven (1961).

9. Cole, Stephen and Cole, Jonathan R., "Scientific Output and Recognition: A Study in the Operation of the Reward System in Science," American Sociological Review 62, 377-390 (1967).

10. Crane, Diana, "The Gatekeepers of Science: Some Factors Affecting the Selection of Articles for Scientific Journals," American Sociologist 2, 4, 195-201, (1967).

11. Zuckerman, Harriet and Merton, Robert K., "Sociology of Refereeing," Physics Today 24, 7, 28-33, (1971).

12. Garvey, William D., Lin, Nan and Nelson, Carnot E., "Communication in the Physical and the Social Sciences," Science 170, 1166-1172, (1970).

13. Xhignesse, Louis V. and Osgood, Charles E., "Bibliographical Citation Characteristics of the Psychological Journal Network in 1950 and in 1960," American Psychologist 22, 778-791 (1967).

14. Van Cott, H. P. and Zavala, A., "Extracting the Basic Structure of Scientific Literature," American Institute for Research (1967).

15. Kessler, M. M., "Some Statistical Properties of Citations in the Literature of Physics," Statistical Association Methods in Mechanized Documentation, Symposium Proceedings (1964).

16. Stevens, Rolland E., "Characteristics of Subject Literatures," Assoc. of College and Reference Libraries Monograph No. 6, 10-21.

17. Hagstrom, Warren, "Factors Related to the Use of Different Modes of Publishing Research in Four Scientific Fields," Communication Among Scientists and Engineers, ed. Carnot E. Nelson and Donald K. Pollock (Lexington, Mass.: Heath Lexington Books, D.C. Heath and Co., 1970).

18. Narin, Francis and Garside, Daniel, "Journal Relationships in Special Education," Exceptional Children, 695-704 (May 1972).

19. Camp, William L., "Guide to Periodicals in Education," The Scarecrow Press, Inc., Metuchen, N.J. (1968).

20. Narin, Francis, Carpenter, Mark P. and Garside, Daniel B., "Exploration of the Possibility of Generating Importance and Utilization Measures by Citation Indexing of Approximately 500 Journals in the Physical Sciences," Contract No. NSF-C 627 for the National Science Foundation, Second Annual Report (August 1972).

21. Carpenter, Mark P. and Narin, Francis, "Clustering of Scientific Journals," to be published.